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IN THE

Supreme Court of the United States.

OCTOBER TERM, A. D. 1926.

No. [redacted] 182

CORONA CORD TIRE COMPANY,

Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,

Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT.

DEAN S. EDMONDS,
FRANK E. BARROWS,
WILLIAM H. DAVIS,
Counsel for Petitioner.

The Evening Post Job Printing Office, Inc., 134 Fulton St., New York, N. Y.

IN THE

Supreme Court of the United States.

OCTOBER TERM, A. D. 1926.

CORONA CORD TIRE COMPANY,
Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT.

TO THE HONORABLE, THE CHIEF JUSTICE AND ASSOCIATE JUSTICES OF THE SUPREME COURT OF THE UNITED STATES:

Your petitioner, Corona Cord Tire Company, a corporation of Pennsylvania, respectfully prays for a writ of *certiorari* to review the decision of the Circuit Court of Appeals for the Third Circuit in the above entitled cause.

Ground for Petition.

The basis for the prayer for the grant of the writ is that two Circuit Courts of Appeals have announced diametrically opposed views on identically the same issue, *i. e.*, the validity of U. S. Letters Patent No. 1,411,231, presented by records which are practically identical; and as a result two of the great industries of the country, the rubber industry and the chemical industry, have been placed in a state of uncertainty on a matter of great concern in those industries, a state of uncertainty which can be terminated only by a ruling by this Court.

Statement.

In support of its prayer, petitioner submits the following facts:

1. The issue on which there is this conflict of opinion between two Circuit Courts of Appeals is the validity of Letters Patent No. 1,411,231 for a Vulcanization Accelerator, granted March 28, 1922, to Dovan Chemical Corporation, as assignee of Morris L. Weiss (Tr. Vol II, p. 1, Pltf.'s Exh. No. 1).

2. Two suits for infringement of that patent have been brought by its owner, Dovan Chemical Corporation, one of them in the Second Circuit and the other in the Third Circuit. The first suit was brought in New York against National Aniline & Chemical Company, Inc., and the second was brought in Pittsburg against your petitioner, Corona Cord Tire Company, nearly a year after the decision of the Court of Appeals for the Second Circuit.

The opinion of the Circuit Court of Appeals of the Second Circuit in the first suit is reported in 292 Fed. Rep. p. 555. The opinion of the District Court in the second suit is reported in 10 Fed. (2d), at page 598, (Tr. Vol. I, p. 687) and that of the Court of Appeals of the Third Circuit in 16 Fed. (2d) at page 419, (Tr. Vol. II, p. 343). The opinion of the District Court in the first suit is not reported. For the convenience of the Court, all four opinions are printed as an appendix to the brief in support of this petition.

3. In the first suit, the District Court held the patent valid and was reversed on appeal, with one member of the Appellate Court dissenting. In the second suit, the District Court held the patent invalid and was reversed on appeal, again with one member of the Appellate Court dissenting. Thus the eight members of the Federal Bench who have

passed upon the validity of the patent have divided equally in their conclusions, four holding the patent valid and four holding it invalid.

4. The validity of the patent was the only issue presented and passed upon in the two suits, infringement or contributory infringement being conceded if the patent were valid. All of the claims of the patent were in issue in both cases.

5. The records presented to the Courts in the two suits are substantially identical. The depositions of seven witnesses who testified in the first suit were introduced in the second suit by stipulation (Tr. Vol. II, pp. 301-340). Six other witnesses in the first case testified in the second. Included in these six are three men whose testimony is by far the most important in both cases.

6. The fact that the conclusions of the two Courts of Appeals are in direct conflict is stated explicitly in the opinion of the Court of Appeals for the Third Circuit in the case at bar, as follows:

> "In reaching the conclusion we have, we regret to find ourselves at variance with those reached by two Circuit Judges of the Second Circuit, reported at 292 Fed. Rep. 555 heretofore referred to."

7. The issue of validity of the Weiss patent is one of far-reaching industrial importance.

It involves the right to manufacture a substance which has been and is being manufactured and sold to the extent of hundreds of thousands of dollars worth each year by several of the largest chemical manufacturing companies of the country. It involves also the right to use that substance and the substance has been and is being used in enormous quan-

tities by many of the largest rubber manufacturing companies of the country in making innumerable different rubber articles, including automobile tires and tubes.

The defendant in the first suit, National Aniline & Chemical Company, Inc., is a manufacturer of chemicals and was charged with contributory infringement.

The defendant in the second suit, Corona Cord Tire Company, is a manufacturer of rubber tires and was charged with direct infringement.

Thus there are two major industries of the country, the chemical manufacturing industry and the rubber manufacturing industry, which have been brought into a state of uncertainty in a matter of great importance to them by the decision of the Court of Appeals of the Third Circuit, in direct conflict with the prior decision of the Court of Appeals of the Second Circuit. They are and must necessarily be uncertain as to whether or not they have incurred liability, and if so what liability, for their past manufacture, and, more important, they are and must necessarily be uncertain as to whether or not continuation of the use of the substance will involve liability. Most rubber manufacturing is done in the Sixth Circuit, particularly in and around Akron, Ohio, and in that Circuit there has been no litigation involving the Weiss patent. To a large extent, the chemicals used by the rubber industry are manufactured in the Second and Third Circuits. As to any liability of the chemical manufacturing companies for manufacture and sale of the patented substance and liability of the rubber manufacturing companies for use of the substance and sale of articles containing it, the situation now presented is that the Weiss patent is valid in the Third Circuit and invalid in the Second Circuit.

In view of the foregoing, we respectfully pray that the Court issue its writ of *certiorari* to the Circuit Court of Appeals for the Third Circuit, to bring the record of the proceedings in this suit before this Court for its consideration,

and that petitioner be granted such other and further relief as this Court shall deem appropriate.

Respectfully,

CORONA CORD TIRE COMPANY,
By DEAN S. EDMONDS,
FRANK E. BARROWS,
WILLIAM H. DAVIS,
Counsel for Petitioner.

Dated, New York, February 18, 1927.

I hereby certify that I am of counsel for the petitioner herein, Corona Cord Tire Company; that I have prepared the foregoing petition in accordance with the request of said petitioner; that I firmly believe that the allegations contained in said petition are true; and that said petition is not made for purposes of delay but is, in my opinion, well founded in law and in fact and should be granted.

DEAN S. EDMONDS,
Counsel for Petitioner.

Dated, New York, February 18, 1927.

IN THE

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, A. D. 1926.

CORONA CORD TIRE COMPANY,
Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

Notice.

TO THE DOVAN CHEMICAL CORPORATION, OR ITS ATTORNEYS:

PLEASE TAKE NOTICE that upon a certified copy of the transcript of record herein, I shall present the petition for writ of *certiorari* hereunto annexed to the Supreme Court of the United States, at the Capitol, in the City of Washington, District of Columbia, on the 21st day of February, 1927, at the opening of Court on that day, or as soon thereafter as counsel can be heard, and I shall then and there move for such other and further relief in the premises as may be just.

DEAN S. EDMONDS,
Solicitor for Petitioner.

Dated, New York, February 18, 1927.

To:
JULIAN S. WOOSTER, Esq.,
Woolworth Bldg.,
N. Y. City.

DUE SERVICE of the foregoing notice, and of a copy of the petition referred to therein, are hereby admitted this day of February, 1927.

Solicitor for Respondent.

Office Supreme Court,
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IN THE

Supreme Court of the United States.

OCTOBER TERM, A. D. 1926.

No. C[redacted]182

CORONA CORD TIRE COMPANY,

Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,

Respondent.

BRIEF FOR PETITIONER

ON

PETITION FOR WRIT OF CERTIORARI

AND

CONFLICTING OPINIONS OF THE LOWER COURTS.

DEAN S. EDMONDS,
FRANK H. BARROWS,
WILLIAM H. DAVIS,
Counsel for Petitioner.

The Stuyvesant Press Law Printing Office, Inc., 114 Nassau St., New York, N. Y.

BRIEF FOR PETITIONER.

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CASES CITED.

Dovan Chemical Corporation *vs.* National Aniline & Chemical Co. Inc., 292 Fed. 555 ..... 3, 11, 18

Dovan Chemical Corporation *vs.* Corona Cord Tire Company, 10 Fed. 2d 598 and 16 Fed. 2d 419. 3, 26, 37

IN THE

Supreme Court of the United States.

OCTOBER TERM A. D. 1926

CORONA CORD TIRE COMPANY,
Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

BRIEF FOR PETITIONER IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

TO THE HONORABLE, THE CHIEF JUSTICE AND ASSOCIATE JUSTICES OF THE SUPREME COURT OF THE UNITED STATES:

We respectfully urge that the petition for *certiorari* filed herein by Corona Cord Tire Company be granted. The situation presented by the petition we believe to be one of direct and irreconcilable conflict between decisions of two Circuit Courts of Appeals, falling within the class specified in section 5(*b*) of Rule 35 of the revised rules of this Court adopted June 8, 1925, as a class in which the grant of *certiorari* is appropriate.

The decisions of the two Circuit Courts of Appeals are diametrically opposed on identically the same issue raised by the same defenses on practically identical evidence, and it seems impossible that the state of uncertainty and confusion now existing in the rubber manufacturing industry and in the chemical manufacturing industry by reason of these conflicting decisions can be terminated otherwise than by a decision of this Court.

The first of the two suits involving the validity of the Weiss patent was terminated in July, 1923, by the decision of the Circuit Court of Appeals of the Second Circuit holding the patent invalid. Since that time, the chemical and rubber manufacturing industries have proceeded on the assumption that there was no occasion to give the Weiss patent further consideration. In that period of three and one-half years, many of the rubber manufacturing companies, including some of the largest of them, have used the patented accelerator in considerable quantities and the accelerator has been made for and sold to them by the large chemical manufacturing companies of the country. The recent decision of the Circuit Court of Appeals of the Third Circuit sustaining the validity of the Weiss patent, presents the possibility of liability for past manufacture during that period of three and one-half years as well as any future manufacture, and also the question as to whether or not a change should now be made to the use of some other accelerator, a change which would involve considerable expense and unavoidable hazard of the quality of the products during the period of completing the change.

Already the recent decision of the Circuit Court of Appeals of the Third Circuit has had effect in making manufacturers of rubber hesitate to use the accelerator of the Weiss patent and to purchase it from the chemical manufacturers who have supplied them heretofore. Thus it has already become evident that unless this Court shall take cognizance of this suit and settle the status of the Weiss patent for all time and for the whole country, the business of the rubber manufacturers and the chemical manufacturers serving the rubber industry will be affected adversely to a substantial extent by reason of the uncertainty which now exists as a result of the conflicting decisions of Courts of Appeals on the validity of the Weiss patent.

The Two Litigations.

The first suit for infringement of the Weiss patent was brought by the owner of the patent, Dovan Chemical Corporation, against National Aniline & Chemical Company, Inc.

The bill of complaint was filed May 29, 1922, approximately two months after the issuance of the patent. It came on for trial in January, 1923, before Circuit Judge Martin L. Manton, then presiding in the District Court, and shortly thereafter, on January 24, 1923, an opinion was filed authorizing the issue of a decree sustaining the validity of the patent and holding that the defendant had infringed (Not reported. See appendix hereto, page 11).

Thereupon appeal was taken to the United States Circuit Court of Appeals for the Second Circuit. That appeal came on for argument before Circuit Judges Rogers, Hough and Mayer, and on July 19, 1923, an opinion was filed holding the patent invalid in all respects and ordering reversal of the decree of the District Court. (292 Fed. 555 and appendix page 18.) The opinion has a note at the foot thereof reading "Judge Mayer dissents". Thereupon a petition for rehearing was presented to the Court of Appeals and that petition was denied. Immediately thereafter, petition for a writ of *certiorari* was presented to this Court by the plaintiff (the present respondent) and that petition was denied (263 U. S. 714).

The suit in which the present petition for *certiorari* is filed is the second suit. It was brought at Pittsburg in the District Court for the Western District of Pennsylvania on June 4, 1924, nearly a year after the termination of the litigation against the National Aniline Company. In the second suit, the Dovan Chemical Corporation is again the plaintiff and the defendant is Corona Cord Tire Company, of East Butler, Pa. This second suit came on for trial before District Judge Robert M. Gibson on October 7, 1925, and on February 3, 1926, an opinion was filed by Judge Gibson holding the patent invalid in all respects and ordering dismissal

of the complaint (10 Fed. 2d, 598. See also Tr. Vol. I, p. 687, and appendix hereto, page 26).

Thereupon appeal was taken to the United States Circuit Court of Appeals for the Third Circuit. That appeal came on for hearing before Circuit Judges Buffington, Woolley and Davis on October 6, 1926, and on December 7, 1926, an opinion was filed holding the patent to be valid and ordering reversal of the decree of the District Court. (16 Fed. 2d, 419. See also Tr. Vol. II, p. 343 and p. 353 and appendix hereto, page 37.) The opinion of the Court has a note at the foot thereof reading "Woolley, Circuit Judge, dissents". Thereupon a petition for rehearing was presented to the Court of Appeals and that petition was denied.

The Records in the Two Suits.

The records presented to the Courts in the two suits are practically identical. The depositions of seven men who testified in the suit against the National Aniline Company were entered in the record of the suit against the Corona Company by stipulation (Tr. Vol. II, pp. 301-340). Also, six of the witnesses who testified in the National Aniline suit, gave their testimony again at the trial of the suit against the Corona Company; included in those six are three witnesses whose testimony was considered by the Courts and by counsel as the most important elements of the two records, namely, the patentee Weiss and his corroborating witness Daniels, for plaintiff, and the alleged prior inventor and prior user, Dr. Kratz, for defendant. Also, many of the documents admitted in evidence as exhibits in the first case were also exhibits in the second, among them being the documents which were considered by the Courts and by counsel as being the most important of all.

In each of the two suits the commission by the defendant of the acts complained of as infringement or contributory infringement was admitted, and no argument of non-infringement was presented by either defendant.

Conflict of the Decisions.

Thus, of the two District Courts which passed upon the validity of the patent, one held it valid and the other held it invalid. The same is true of the two Courts of Appeals, and the decisions of the two Courts of Appeals do not represent the unanimous view of the Judges who heard the appeals as in each instance one Circuit Judge dissented. Of the eight Judges who have passed upon the validity of the patent, four have held it valid and four have held it invalid.

The direct conflict of the decisions of the Courts of Appeals of the Second and Third Circuits is clear, both as to the primary issue of validity or invalidity of the Weiss patent and also as to various subsidiary issues controlling the decision on the primary issue. The opinion of the Court of Appeals for the Third Circuit in this *Corona* case states the fact of direct conflict explicitly. The opinion ends with the following:

> "In reaching the conclusion we have, we regret to find ourselves at variance with those reached by two Circuit Judges of the Second Circuit reported at 292 Fed. Rep. 555 heretofore referred to."

One of the subsidiary issues above referred to is the defense of prior knowledge which was urged in both suits. In the *National* suit, the Court of Appeals of the Second Circuit held specifically that prior to the earliest date of invention claimed for Weiss, the superior activity of the patented accelerator was known to Dr. Kratz and his associates. The Court said (292 Fed. Rep. 559):

> "But if we are wrong about this" (that Weiss's work prior to a certain publication was "merely experimental and guided by no principle") "and if making small experimental slabs of rubber or shoddy with DPG as the accelerator constituted embodiments of Weiss's disclosure, then we find, on what we regard as the clearest evidence, that Dr. Kratz did the same thing in 1916."

The Court also said a little further along in its opinion:

> "It follows that, taking this patent at the patentee's own value, and accepting, for purposes of decision only, his view of what he invented and how he embodied that invention, Dr. Kratz and associates were ahead of him in every step."

The Court of Appeals of the Third Circuit in passing on the *Corona* case included in its opinion no detailed statement of reasons why it differed from the Court of Appeals of the Second Circuit on this defense of prior knowledge, but its general discussion makes it manifest that it took a directly opposite view from that expressed in the foregoing quotation.

Another of the subsidiary issues referred to is the defense of prior use which was also urged in both suits. The proof of the alleged prior use rests largely in the testimony of a single individual (Tr. Vol. I, p. 337 *et seq.*), though his testimony is corroborated by related facts and by documents, the latter including a formula written by the witness in a laboratory note-book kept by him in the regular course of his work (Tr. Vol. II, p. 250). This defense of prior use was sustained by the Court of Appeals of the Second Circuit in the *National* case. The Court recognized the limitations of the corroboration, but was of the opinion that a prior use is proved if the evidence submitted makes the Court feel certain that the use occurred as alleged. The Court said (292 Fed. Rep. 559):

> "Further, when we perceive how closely his acts in 1916 correspond with his essay of 1919, we believe his evidence, though uncorroborated, that in 1917 he made rubber tires and sold them using DPG as the accelerator; and this is more than Weiss even claims to have done before application filed."

On this point also the opinion of the Court of Appeals of the Third Circuit in this *Corona* case includes no statement in detail of reasons for rejecting this defense of prior use, but the opinion makes it plain that the defense was rejected.

A third subsidiary issue involved the date of invention proven by the patentee. The opinions of the two Courts of Appeals are specific in the statement of the conclusions reached, and in those conclusions the two Courts are directly opposed. The Court of Appeals of the Second Circuit in the *National* case said that any work which the patentee may have done prior to a certain publication of the patented invention was inconclusive and produced nothing of value. The Court said (292 Fed. 559):

> "But, for purposes of decision, we accept all his evidence of prior efforts, experiments, or reductions to practice, and will assume that as early as the autumn of 1918 he had not only experimented with DPG as an accelerator, but produced vulcanized rubber with its use. This is a larger assumption than plaintiff can demand on the evidence; yet it cannot avail.
>
> "We do not believe that any one regarded DPG as a seriously preferable accelerator until after the Kratz paper, because that chemist was plainly on this record the first to give comparative figures demonstrating the great saving of time following the use of DPG. He gave definite and persuasive reasons for the preference. We therefore incline to regard all the pre-Kratz work as merely experimental, and guided by no principle. Kratz gave the crucial information as to time saving."

The direct contrary of this is stated to be the conclusion of the Court of Appeals of the Third Circuit in this *Corona* case. The critical date, that of the publication, was September, 1919, and the Court held that prior to that date the patentee had demonstrated the value of the patented accelerator to such a complete extent as to warrant the Court in holding that he had completed the act of invention then. The Court said:

> "Under date of February 21, 1919, another successful test, this time with a shoddy compound, was entered in the same book and another with shoddy on March 4, 1919. These experiments proved the workable worth of DPG as an acclerator in vulcanizing rubber."

Another respect in which the views of the two Courts of Appeals are directly opposed on a matter which had a material effect in leading to the opposed conclusions reached by them, concerns the effect to be given to another patent taken out by this same man Weiss and also owned by the plaintiff (Tr. Vol. II, pp. 297-8). That other patent, which is *not* in suit, discloses and claims a chemical process for the manufacture of the accelerator described and claimed in the patent which *is* in suit. On the question of the bearing of that other patent covering a process for *making* the accelerator on the validity of the patent in suit covering the *use* of that substance as an accelerator however the substance be made, the two Courts of Appeals held directly opposite views. The Court of Appeals of the Second Circuit said, in the *National* case (292 Fed. Rep. 558):

> "The claims in suit would be just as good or bad as they are now, if DPG were worth as much as radium; and if neither Weiss nor anyone else were able to furnish the chemical except in laboratory quantities and by laboratory methods."

On the other hand, the Court of Appeals of the Third Circuit in this *Corona* case referred repeatedly to the other Weiss patent not in suit as showing some great accomplishment by Weiss warranting sustaining the patent which is in suit. For instance, the Court said that if Weiss

> "showed the world in addition how to make this product in commercial quantity in the rubber vulcanizing art, it would seem to us, and we so hold, that a claim, such for example as his eighth" (which was quoted) "was inventive in character and valid."

Conclusion.

From the foregoing, it must be evident that there is direct and irreconcilable conflict between the decisions of the two Circuit Courts of Appeals, as to the primary issue of validity or invalidity and also as to the specific defenses of prior knowledge, prior use and prior publication.

The practical effect of this conflict of decision will inevitably be, and in fact has already been, to create a condition of uncertainty and confusion in the rubber manufacturing industry and in that part of the chemical manufacturing industry which serves the rubber manufacturers. The men directing those industries are at a loss to know how to guide their business course. They have to face the condition that the Weiss patent is valid in the Third Circuit and is invalid in the Second Circuit. Most rubber manufacturing is carried on in the Sixth Circuit, centering around Akron, Ohio, and in that Circuit there has been no litigation involving the patent. But the rubber products of the enormous Akron factories are sold all over the country and enjoining the sale of rubber articles made at Akron may be attempted in the Third Circuit at any time. That is one of the elements of the uncertainty in which the rubber manufacturing industry finds itself. Another is the possible liability for past manufacture. Another is whether or not it is advisable to effect a change of factory practice to use of some other accelerator, a change which is difficult, expensive, time-consuming and hazardous. Another of the elements of uncertainty is whether or not to purchase the patented accelerator from the patent owners, paying for it the higher price which is the inevitable concomitant of a restricted source of supply. Also, the chemical manufacturers are in a similar state of uncertainty as to their liability, past and future, and as to their ability to hold, and the desirability of holding, the trade of the rubber manufacturers to whom they have been supplying accelerators up to the present time.

It seems clear, therefore, that a situation has been produced by these conflicting decisions of Courts of Appeals which should not continue and which can be brought to an end only by the decision of this Court.

Respectfully submitted,

DEAN S. EDMONDS,
FRANK E. BARROWS,
WILLIAM H. DAVIS,
Counsel for Petitioner.

Dated February 18, 1927.

Appendix

OPINIONS OF THE COURTS

OF THE

SECOND AND THIRD CIRCUITS

ON THE

VALIDITY OF WEISS PATENT No. 1411231.

UNITED STATES DISTRICT COURT,

FOR THE SOUTHERN DISTRICT OF NEW YORK.

DOVAN CHEMICAL COMPANY,
Plaintiff,

AGAINST

NATIONAL ANILINE & CHEMICAL CO., INC.,
Defendant.

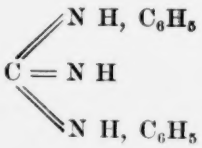
DRURY W. COOPER, Esq., EDWARD W. VAIL, Esq.,
Of Counsel for Plaintiff.

DEAN S. EDMONDS, Esq., FRANK E. BARROWS, Esq.,
Of Counsel for Defendant.

Opinion of Circuit Judge Manton.

The patent in suit, No. 1,411,231, was applied for November 12, 1921 and granted March 28, 1922, and is for vulcanization accelerators. It is a process for improving rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purposes. In the art, when certain organic substances was added to rubber mix during the compounding, a catalytic or similar action is produced which causes the rubber or gum to unite or react more rapidly or thoroughly with sulphur or other vulcanizing agents. The inventor discloses that

diphenylguanidine is particularly effective for this purpose. The formula indicated is given as



Recognizing that di-substituted guanidine produced by laboratory methods had been known to chemists for years, to be used in accelerators of this type, it was thought that di-substituted guanidine was not known to be efficacious or useful as accelerators in vulcanizing, nor could it be produced in sufficiently large quantities in a substantially pure form or at a sufficiently low price to be available for this purpose, and the inventor says that the use of diphenylguanidine had been unknown prior to his researches and that he found it much more powerful and effective as an accelerator in vulcanization than triphenylguanidine. The diphenylguanidine not only hastens the vulcanization but results in a final product much superior in texture, durability and aging qualities over that when triphenylguanidine is used. A greatly improved product results, particularly as regards elasticity, aging qualities and a freedom from bloom. The method of carrying out the invention is illustrated as follows: the rubber may be compounded in proportions of 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, 1 part by weight of diphenylguanidine. They are mixed together in a suitable way, such as by milling and then vulcanized or cured in molds under heat corresponding to steam pressure of about forty pounds per square inch. This vulcanizing temperature is continued until the compound is suitably vulcanized, which requires from ten to twenty minutes, depending upon the shape and size of the article being vulcanized. This accelerator is useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which

are required to be more elastic and flexible, such as automobile tires. Indeed, this accelerator has been so successful that a large demand has been built up and a market created for it, and several of the large chemical corporations are manufacturing it. The purchasing public shows a willingness to pay for it. This is a practical illustration of its substantial value. Again, the defendant is using the process, and it too has built up a large and profitable business.

It is urged by the defendant that three others, prior to Weiss, tested diphenylguanidine as an accelerator. One George D. Kratz read a paper in September, 1919, at a meeting of the Chemical Society of Philadelphia in which diphenylguanidine was referred to as an accelerator. He, called as a witness, testified that he incorporated some twenty to thirty grams of diphenylguanidine in some tire tube stock which was sold to the Rubber City Clearing House at Akron, Ohio, in 1917. In his paper, Mr. Kratz, said, speaking of his work: "We have chosen to employ only substances which have previously been cited by others and whose definite chemical composition permits comparisons with homologs or other closely related compounds." And he says that "the activities of the substances from a practical standpoint were considered of secondary importance". A mere reading of the paper before this Society is not a statutory publication under Sec. 4886 of the Revised Statutes. There was a publication in the Chemical and Metallurgical Engineering on October 1, 1919. What was printed there does not disclose the invention or give it into the possession of the public fully, so that it might be practically and publicly employed. There was a complete publication by Kratz and others in the Journal of Industrial & Engineering Chemistry for April, 1920, and the application for the patent in suit was filed November 12, 1921. This publication was less than two years prior to the filing of the first Weiss application which was on July 22, 1921. That paper refers to diphenylguanidine as being an accelerator, but it was Weiss who was the first one to adequately test, by actual experience and to overcome the prac-

tical difficulties there were in the way of the accomplishment. Weiss was employed by the Republic Rubber Company of Youngstown, Ohio, in the Fall of 1917, and was under the supervision of the chief chemist Daniels. Up to March 8, 1918, Weiss was associated with one Carlton, who went with the Republic Company in June, 1917, about four months prior to Weiss' engagement. Carlton says that he had frequent conversations with Weiss with regard to accelerators, and that he pointed out to him many organic compounds suggesting that they be tried. It was impossible to try them except those which were easily obtainable on the market or very easily prepared, and Weiss referred him to "Richter's Organic Chemistry" and suggested after reading from that, that diphenylguanidine might be an accelerator. It was after this that Weiss went to Pittsburgh to the Carnegie Library to obtain further information on the subject of guanidines from the literature there available. He made this investigation the first week of January, 1919, under Mr. Daniels' direction. Daniels then become interested in developing diphenylguanidine as an accelerator and said that in the Fall of 1918 "I knew he had some results that looked pretty good." After returning from Pittsburgh, some tests on rubber compound were made, the result of which was shown under date of February 10, 1919 and after that another test was made on the shoddy compound under date of March 21, 1919. Another test was made March 4, 1919, and still there was another under date of September 29, 1919, and again October 12, 1919, in which diphenylguanidine prepared by the new process Mr. Weiss introduced. In the Fall of 1919, Weiss supplied Mr. Daniels with diphenylguanidine for his personal use. The X-book record of the Republic Company shows various tests made by Weiss. It demonstrates extensive work by him experimenting to ascertain the value of diphenylguanidine as an accelerator in various compounds adapted for practical use. The first test slabs were shown to Mr. Daniels at the time of Weiss' Pittsburgh visit. These slabs were made in December, 1918. The Weiss tests re-

corded in the Spring of 1918, were before the reading of the Kratz paper, and demonstrate that Weiss had been working on the production of diphenylguanidine in commercial quantities. He left the Republic Company on March 15, 1920. Thereafter, he visited rubber companies and at their places talked on this subject and exhibited slabs of rubber that had been cured with the use of diphenylguanidine. He then returned to New York, being unsuccessful in obtaining a position with the various rubber companies, visited the offices of the defendant and made application for employment, but did not succeed. He later visited the States Metals Company (afterwards the selling agent for the plaintiff herein) and interested officers of the plaintiff company. In May, 1920, after the organization of the plaintiff company, a plant was built in Brooklyn, New York, where diphenylguanidine was manufactured for commercial use.

The X-book referred to proved to have page 2005 torn out. This was subsequently found. This records in the first column a test of the use of diphenylguanidine and is said to have been made by Baldwin. The rest of the entries were made by Weiss. That column was under date of February 23, 1917, whereas all the other entries (none record the use of diphenylguanidine) were made in the year 1918. I am not satisfied that there was such an entry of an experiment as is indicated in column 1 at the time Weiss entered his record regarding the use of diphenylguanidine. It is not shown where Baldwin obtained diphenylguanidine to experiment with. Baldwin's testimony as to this experiment is unsatisfactory and I decline to accept it.

Kratz is said to have disclosed his idea to others in 1916. It is said that then he experimented and reached definite conclusions as to diphenylguanidine while working for the Norwalk Rubber Company and that what he did at the Norwalk Company constituted a reduction to practice as also the occasion of making the tubes for the Falls Rubber Company in 1917. He says, speaking of his work at Norwalk under date of November 1, 1916 (report from Norwalk plant,

Exhibit E), that it gives the relative accelerating values of certain substances tested. But what he did appears to have been a laboratory experiment which was abandoned because nothing further was then done until the later effort at reduction when employed by the Falls Rubber Company where the tubes were manufactured as above referred to. There thirty grams of diphenylguanidine were mixed with rubber stock made into inner tubes for automobiles and such tubes were sold as blemished rubber in Akron, Ohio. No further commercial use was made. The amount of acceleration used could have had no substantial effect in curing of the rubber as compared with that used in plaintiff's process. The burden of proof is upon the defendant to establish the defense of prior public use. When the application was in the patent office, the Kratz paper was referred to, as were his experiments, and a hearing was had there. I think the issuance of the letters patent carried with it the presumption of validity and, in view of the defense offered here, should be established beyond every reasonable doubt. (*Coffin* vs. *Ogden*, 18 Wall. 120):

> "The prophetical suggestions in English patents of what can be done, when no one has ever tested by actual and hard experience and under the stress of competition the truth of these suggestions, or the practical difficulties in the way of their accomplishment, or even whether the suggestions are feasible, do not carry conviction of the truth of these frequent and vague statements." (*Westinghouse Air-Brake Co.* vs. *Great Northern Ry. Co.*, 88 Fed. at 263.)

Mere vague and general representations will not support such a defense as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art or science to understand the nature and operation of the invention and to carry it into practical use. Whatever may be the particular circumstances into which the publication takes place his account published, to be and in effect to support such a defense, must be an account of a complete

and operative invention capable of being put into practical operation. (*Seymour* vs. *Osborne*, 11 Wall. 516.)

I am satisfied that the use of diphenylguanidine as in the plaintiff's process, involved invention. Using it advanced the art of rubber making. Its utility and the consequences which followed, fully support the real practical test of the sufficiency of an invention. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed. (*Smith* vs. *Goodyear*, 93 U. S. 486.) This substitution involved a new process of manufacture to develop a new use of the properties of diphenylguanidine and there was a new and useful result obtained. (See *Smith* vs. *Goodyear*, *supra*; *Rumford Chemical Works* vs. *N. Y. Baking Powder Co.*, 134 Fed. 385; *Genl. El. Co.* vs. *Hoskins Mfg. Co.*, 224 Fed. 464.) A complete and successful invention should not be voided by proof of a number of incomplete and imperfect experiments made by others at an earlier date. Even though the experimenters may have had the idea of the invention and may have made partially successful efforts to embody it in a practical form, there is not sufficient to defeat an issued patent. This applies in cases arising under patents for chemical products. (*Amer. Wood Paper Co.* vs. *Fibre Disintegrating Co.*, 23 Wall. 566.) An invention to be patentable should be complete and capable of producing the result and one who has been successful in his efforts should not be deprived of the consequences of that success merely because someone came near it theretofore. (*Diamond Patent Co.* vs. *Carr Co.*, 217 Fed. 400.)

I think Weiss is the discoverer of the process which has borne such good results that the plaintiff as assignee should be accorded the benefits thereof.

Decree for plaintiff.

Dated: January 24, 1923.

MANTON,
United States Judge.

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE SECOND CIRCUIT.

Before:

Hon. HENRY WADE ROGERS,
Hon. CHARLES M. HOUGH,
Hon. JULIUS M. MAYER,
Circuit Judges.

DOVAN CHEMICAL CORPORATION,
Plaintiff-appellee,

vs.

NATIONAL ANILINE & CHEMICAL COMPANY, INC.,
Defendant-appellant.

Appeal from decree in Equity entered in the District Court for the Southern District of New York.

Suit is on all the twelve claims of Patent No. 1,411,231, granted March 28, 1922, to plaintiff, as assignee,—on the application of Weiss filed November 12, 1921.

On July 2, 1921, Weiss filed an earlier application, for a "Process of Making Diphenylguanidine",—a chemical around which this litigation revolves, and which is called in the record D. P. G.;—an abbreviation that will be used in this opinion. This application also ripened into a patent; No. 1,422,506, on July 11, 1922; but the present suit is not brought thereupon. Its existence and nature, however, have an important bearing on the case at bar. This earlier application was also assigned to plaintiff before issue.

D. P. G. is a substance long known to chemists, but produced, before Weiss invented his above referred to process,—only with difficulty and expense. It was a laboratory and not a commercial product. This is the assertion of the application of July, 1921, and may be assumed as true for purposes of discussion. Thus, by the date just given at the latest, Weiss conceived that he knew how to produce D. P. G. in quantity and under commercial conditions.

The application for the patent in suit is labelled as one for a "Vulcanization Accelerator", and its asserted object is "to improve rubber compounds" in two particulars, 1st by imparting to "the finished product, * * * superior quality", and 2nd, by reducing "the time required for vulcanization". The first asserted excellence, need not be discussed; for present purposes it is unimportant if not immaterial; the second is admitted, in a certain sense, viz: that D. P. G. is an "accelerator" of merit, its acceleration is more active than that of most if not of all the substances previously used, its adoption is very recent, and no commercial or manufacturing use is known for it except in vulcanization.

An "accelerator" is any substance organic or inorganic which when mixed in due proportion with the mass prepared for vulcanization, hastens that process by a chemical action generally described as catalytic. D. P. G. is but one member of what the testifying chemists call the guanidine group, which includes T (tri) P. G. and M (mono) P. G.; and T. P. G. was a known and commonly used accelerator for some years before Weiss.

In this state of affairs, Weiss said in his application for the patent in suit:

> "I am aware that T. P. G. has been suggested, and probably used to some extent, as an accelerator in the vulcanization of rubber, but the use of D. P. G. for that purpose appears to have been unknown prior to my researches on this substance."

He then proceeds further to assert that he had discovered "di-substituted guanidines", though "particular D. P. G.",

to be effective accelerators; but the disclosure does not reveal any reason for this summary extension of efficiency and invention to a class of which D. P. G. is but a member. Finally the specification defines D. P. G. by formula, and gives the ingredient proportions of the mass for vulcanization; but neither particular is new.

The foregoing is the sum of disclosure; and on it Weiss founded claims (allowed as propounded) for both process and product; so drawn as to cover not only the use of D. P. G., but of any di-substituted guanidine. This scheme of invention-definition, is illustrated by claims one and twelve, which are as follows:

> (1) The process of treating rubber or similar materials, which comprises combining with the rubber compound a di-substituted guanidine.
>
> (12) A vulcanized compound of rubber or similar material combined with a vulcanizing agent and D. P. G.

Plaintiff as assignee was thus armed with one patent for a special method of producing D. P. G., and another which in effect covered the use, in rubber vulcanization,—of a family or group of guanidines including D. P. G. however produced.

Defendant has made D. P. G., and sold it to persons who in all probability would use all or most of it in vulcanizing rubber; and especially in preparing tires for motor-cars,—this being the commercial demand of the day stimulative of inventions such as the one at bar. But, so far as this record shows, defendant's D. P. G. does not infringe Weiss' process for making that chemical; therefore defendant is sued herein as a contributory infringer of No. 1,411,231, which is described in the bill as covering an "improvement in vulcanization accelerators and in the process of treating rubber, and in the vulcanized rubber compound in which said accelerator is used."

Plaintiff prevailed below, and defendant was by decree declared to have "contributed to the infringement (of the patent in suit) by manufacturing, selling and causing to be used D. P. G. as an accelerator in the vulcanization of articles made of rubber." Decree awarded to plaintiff "the profits, gains and advantages" derived from such infringement, with the usual injunction. Whereupon defendant appealed. Further references to the evidence will be made in our opinion.

DEAN S. EDMONDS and FRANK E. BARROWS for defendant-appellant;

DRURY W. COOPER, JAMES R. SHEFFIELD and EDWARD W. VAILL, for plaintiff-appellee.

HOUGH, *C. J.*

There are several matters, raised by the pleadings and treated in argument, that we shall lay aside at once, as not necessary for decision; however interesting in themselves or important in other cases.

Thus we express no opinion as to whether,—considering the long existing knowledge of D. P. G., and the pre-existing actual commercial use of T. P. G. for acceleration,—it constituted patentable invention in Weiss to muster in the former chemical as an accelerator.

For the same reason we shall not consider the argument that such of the claims in suit as seek to monopolize all disubstituted guanidines (Nos. 1, 5 and 9) cannot be valid if taken literally.

Nor is it necessary to decide whether there was error in awarding against a contributory infringer, under the circumstances shown,—recovery of profits;—as distinct from damages.

What must be decided are certain questions of fact, and the answers we shall give will dispose of the whole litigation. These questions may be thus framed:—(1) What did

Weiss invent according to his own statements, and that word includes not only what he swore to in his specification, but what he similarly affirmed in affidavits and on the witness stand. (2) When did he make the invention in question? On the answers to these queries will depend our finding as to the duly pleaded defense that "prior to the alleged invention (by Weiss) the same and every material part thereof were (if there be any patentable invention therein) invented by" other persons named;—or one or some of them.

What Weiss invented, he tells in his specification thus,—"I have found that D. P. G. is much more powerful and efficacious as an eccelerator in vulcanization than T. P. G."; and nothing in plaintiff's evidence enlarges, improves or contradicts this simple statement. The claims too, when the increment of using the phrase "di-substituted guanidines" instead of D. P. G. is disregarded, mean substantially just what Weiss swore to; and the whole application might be condensed into one sentence,—"I claim the use of D. P. G. as an accelerator, because I was the first person who observed its efficacy for that purpose."

We are assuming that what might be called a "patent of observation" is good in law, and good when wholly disassociated from any method of producing that of which the beneficial use is observed. And this leads us to point out here, how Weiss' earlier application for "A process of making D. P. G.," clouds the present issue.

The claims in suit would be just as good or bad as they are now, if D. P. G. were worth as much as radium; and if neither Weiss nor anyone else were able to furnish the chemical except in laboratory quantities and by laboratory methods. Of course, in such case, this litigation would never have arisen, and the patent at bar would probably never have been sought, because in a practical sense it is but a pendant or "clincher" to the process patent; yet in legal theory the patentable invention here displayed would be just as good or bad as it would be if it had no more relation to the com-

mercial or practical arts than had the "Edison Effect" when it was granted patent protection more than a generation ago.

In making the foregoing summary of invention, we agree with the patent Examiner who remarked that Weiss' application was "no more than a broad disclosure of the use of (D. P. G.) without disclosing any details other than those usually employed with accelerators of this class."

Assuming now invention in this "broad disclosure", and proceeding to the query as to when Weiss invented,—the date September 2d-6th, 1919, is important. On those days the American Chemical Society met in Philadelphia, the meeting was largely attended by chemists, Weiss did not go, but his superior officer (practically his employer) did. At that meeting Dr. Kratz read an essay prepared by himself and his assistants on "The action of certain Organic Accelerators in the Vulcanization of Rubber." We hold that essay to be a complete disclosure of everything in the application for the patent in suit, and of a great deal more useful and accurately stated information.

The Kratz essay was subsequently published, but only within less than two years of Weiss' filing date. Appellee seems to complain that defendant treats this spoken essay as a publication under R. S. 4886. We perceive no such contention, it would of course be untenable; but the assertion is made, and we agree with it that Dr. Kratz invented whatever Weiss did before the latter had any concept of invention; therefore Weiss was not the "first, sole, true and original inventor", as the bill asserts.

The quotation above made from the file-wrapper contents, is part of what the Examiner said, when he confronted Weiss' solicitors with the publication of Kratz's essay. Their reply was not to call attention to the date of publication and rely on R. S. 4886; there was obvious recognition of the truth of the Examiner's criticism, and Weiss fell to affidavit making, (under Office Rule 75), and carrying back his date of invention, so as to antedate Kratz's reading of his essay.

The reason and the only reason for this, is that Kratz by that essay proclaimed himself and his associates as having observed that D. P. G. was a better accelerator than T. P. G. *inter alia;* and this, as we have pointed out, and as the Examiner in substance said, was and is the sum total of this invention.

Dr. Kratz was naturally not heard from in the Patent Office, and the patent was carried through by these affidavits. The same method was used at trial, but Dr. Kratz and his associates and records were there. We have carefully studied that evidence and Weiss' testimony which is not wholly reconcilable with some of the affidavits used in the office.

It is proven by plaintiff's witnesses that Weiss' superior came back from Philadelphia and listening to Kratz's essay, and told Weiss and others that he was convinced that "D. P. G. had a good deal on T. P. G.", and gave orders to Weiss to experiment with the now preferred chemical. There is no doubt that the patentee was thus spurred on by Kratz. But, for purposes of decision, we accept all his evidence of prior efforts, experiments or reductions to practice, and will assume that as early as the autumn of 1918, he had not only experimented with D. P. G. as an accelerator, but produced vulcanized rubber with its use. This is a larger assumption than plaintiff can demand on the evidence; yet it cannot avail.

We do not believe that anyone regarded D. P. G. as a seriously preferable accelerator, until, after the Kratz paper, because that chemist was plainly on this record the first to give comparative figures demonstrating the great saving of time following the use of D. P. G. He gave definite and persuasive reasons for the preference. We therefore incline to regard all the pre-Kratz work as merely experimental, and guided by no principle, Kratz gave the crucial information as to time saving.

But if we are wrong about this, and if making small experimental slabs of rubber or shoddy with D. P. G. as the accelerator constituted embodiments of Weiss' disclosure, then we find on what we regard as the clearest evidence that Dr. Kratz did the same thing in 1916. Further when we perceive how closely his acts in 1916 correspond with his essay of 1919, we believe his evidence, though uncorroborated, that in 1917 he made rubber tires and sold them, using D. P. G. as the accelerator; and this is more than Weiss even claims to have done before application filed.

It follows that taking this patent at the patentee's own value, and accepting for purposes of decision only, his view of what he invented and how he embodied that invention, Dr. Kratz and associates were ahead of him in every step. Therefore on this record they were the inventors (if any patentable invention exists) and not Weiss.

Decree reversed with costs, and cause remanded with directions to dismiss the bill with costs.

JUDGE MAYER DISSENTS.

IN THE

DISTRICT COURT OF THE UNITED STATES

FOR THE WESTERN DISTRICT OF PENNSYLVANIA

DOVAN CHEMICAL CORPORATION, Plaintiff, vs. CORONA CORD TIRE COMPANY, Defendant.	In Equity No. 1109

BYRNES, STEBBINS & PARMELEE, Solicitors for Plaintiff, JULIAN S. WOOSTER and JAMES J. KENNEDY, Counsel.

WINTER, BROWN & CRITCHLOW, Solicitors for Defendant, DEAN S. EDMONDS, FRANK E. BARROWS, RAYMOND F. ADAMS and FREDERICK W. WINTER, Counsel.

Opinion.

GIBSON, *District Judge.*

The plaintiff, DOVAN CHEMICAL CORPORATION, assignee of Morris L. Weiss, has brought its action against the defendant, CORONA CORD TIRE COMPANY, for alleged infringement of Weiss Patent No. 1,411,231 for a vulcanization accelerator. The application was filed November 12, 1921, and the patent was granted March 28, 1922. The plaintiff prays the ordinary injunction, the delivery to the plaintiff or destruction of di-substituted guanidines (and particularly diphenylguanidine) which defendant may have, and an accounting.

Crude rubber, as such, is of little value. When mixed with sulphur and other materials, and subjected to heat, it

becomes the rubber of commerce. This mixture and application of heat is termed vulcanization, and a "vulcanization accelerator" is a material added to the mixture which not only hastens vulcanization (as its name indicates), but also increases the elasticity and otherwise improves the quality of the rubber article being manufactured. By the patent in suit monopoly in the use of diphenylguanidine and di-substituted guanidines, as such accelerators, is claimed.

The defendant, by stipulation, has admitted the purchase of diphenylguanidine, and use of it in the proportion of two-thirds of 1% of the rubber as an accelerator of vulcanization, but has denied the validity of the patent. It alleges that one Dr. G. D. Kratz, on September 6, 1919, more than two years before the application for the patent in suit, disclosed the subject-matter of the patent in a paper read at a convention of chemists engaged in the rubber industry held at Philadelphia, which paper was printed in the JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY in April, 1920, and that thus the full information of the patent was anticipated. It further declares that Kratz was the discoverer of diphenylguanidine as a vulcanizer accelerator, not Weiss; that tubes made in 1917 by Kratz from a rubber mixture, with that accelerator, were sold; that Weiss was not an originator of the idea of the use of diphenylguanidine as an accelerator, having obtained it from one Baldwin, who had experimented therewith; and finally, that the patent does not disclose a patentable invention.

Plaintiff has particularly relied upon Claims 5, 8, 9 and 12 of the patent, which follow:

> "5. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine accelerator."
>
> * * * * * *
>
> "8. The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine."
>
> * * * * * *

"9. A vulcanizing compound of rubber or similar material combined with a vulcanizing agent and a di-substituted guanidine."

* * * * * *

"12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine."

In view of the stipulated use of diphenylguanidine by the defendant, our inquiry in the instant matter is properly confined to a determination of the validity or invalidity of the 8th and 12th claims.

In discussing them, monophenylguanidine will be abbreviated to MPG, diphenylguanidine to DPG and triphenylguanidine to TPG.

It has been argued by counsel for defendant—and with considerable force—that, no matter who introduced the use of DPG as an accelerator, no patent for such use was an actual invention, or displayed the inventive faculty, when application was made as late as November 12, 1921. The contention is, in substance, that for at least six years prior thereto rubber chemists had accepted the fact that vulcanization accelerators were nitrogen-containing substances capable of certain reactions in the presence of sulphur. Among the substances known to meet the general chemical requirements of accelerators in this respect were the guanidines, which included MPG, DPG and TPG. TPG was known to be an accelerator, and was in use as such before the patentee, Morris L. Weiss, began his career as a rubber chemist; and prior to its use the possibility of the guanidines, as accelerators had been suggested in magazine articles. DPG is closely related to TPG in chemical construction, and when it was established that the latter was an accelerator of value, it followed as a matter of natural presumption that DPG was also an accelerator. To determine the correctness of this presumption, and the value of the substance, and the best way to use it, the rubber chemist was required, it is claimed, to exercise no inventive faculty, but mere industry in making tests and the ordinary knowledge of his profession. With

the knowledge of the fact that one member of a closely related group was an accelerator, the qualities of another member offered no greater problem to the chemist, except in time of solution, than would be offered to a pipe-fitter altering the plumbing in a building. Each would be required to use only the ordinary tools of his trade, the one his ability to prepare and treat a rubber composition, the other his wrench and mechanical ability.

While the contention, just stated, might require careful consideration under some circumstances, we have not based our decision upon it, but have come to the conclusion upon other grounds that the patent in suit is invalid. The testimony, in our judgment, conclusively establishes the fact that Morris L. Weiss was not the inventor or discoverer of the efficacy of DPG as a vulcanization accelerator—the only actual disclosure of the patent.

It is manifestly impossible that a synopsis of the testimony be here given. Certain admitted facts, as well as disputed testimony, tend strongly to sustain the finding. Morris L. Weiss, having just received a degree in Chemistry from Cooper Union, of New York City, late in 1917, entered the employ of The Republic Rubber Company, of Youngstown, Ohio. That company was engaged in the manufacture of rubber articles largely made from "shoddy", or reclaimed rubber. Like most other rubber manufacturers, in 1918-9 it was interested in obtaining other and improved accelerators, but was specially interested in TPG, and was engaged in building a plant for its commercial use. Weiss, in addition to his usual work, was engaged in experiments upon accelerators, among them TPG. He was required by the rules of the Company to enter all his experiments in a book, called the "X Book" kept for the purpose. During the term of Weiss' employment, prior to September 7, 1919, this X Book shows two experiments with DPG as an accelerator, which are undisputed, and a third which shows a change of its original date and which defendant claims was subsequent to that date. The undisputed tests were with a "shoddy" mixture,

and show no marked superiority of DPG over TPG. The disputed test was not with the shoddy stock of the company, and showed a considerable and marked superiority. On September 6, 1919, one Dr. G. D. Kratz, with a chemistry degree from Cornell University, read a paper upon accelerators before the American Chemical Society at Philadelphia. In it he fully disclosed the subject-matter of the Weiss patent, more fully, indeed, than does the patent. *Inter alia*, he placed a table upon a blackboard, giving the comparative powers of DPG, TPG and other accelerators, aniline being the basis of the comparison. The immediate superior of Weiss in the Republic Rubber Company, M. H. Daniels, was present when this paper was read and copied the tables placed upon the blackboard; and this information was imparted to Weiss upon the following day. After this date the "X Book" shows the use of DPG in a number of tests. In March, 1920, Weiss was discharged by the Republic Rubber Company, and very shortly thereafter applied for employment to two other rubber manufacturers. In both his written applications he referred to the paper read by Dr. Kratz as showing the value of DPG as an accelerator, and stated that he had devised a method of manufacturing that substance cheaply; but in neither did he claim to have been the original discoverer of it as an accelerator. Later in 1920, Weiss with others organized the plaintiff company. On July 2, 1921, Weiss made application for a patent to cover his method of preparation of DPG, and received it on July 11, 1922. As stated, the application for the present patent was filed November 12, 1921, and the patent issued March 28, 1922. The patent examiner cited Dr. Kratz's paper before the Chemical Society, published in a magazine in April of 1920, as an anticipation of the patent. Upon affidavits being furnished by Weiss to sustain a claim that he had discovered the qualities of DPG as an accelerator prior to the Kratz paper, the patent eventually was issued. The proceeding in the Patent Office was entirely *ex parte*, and no testimony was introduced to show any discovery by Kratz prior to the reading of his paper. It

will be noted, also, that the patentee accepted the Kratz paper as a disclosure of the invention claimed in his patent and sought to show the priority of his own discovery, while in the instant case the plaintiff questions the sufficiency of the paper as a disclosure.

The patentee, Weiss, has testified that he began to investigate DPG early in 1918 and made a number of tests with it prior to February of 1919. Despite the rule that all tests should be recorded in the "X Book", no test of DPG appears therein prior to February, 1919, except one by Weiss' predecessor, Baldwin, in 1917. Three tests appear under dates of the early part of the year 1919. Of these, two are in connection with shoddy compounds, and were of little significance. The other now appears of the date "2-10-19." A casual examination discloses that the month has been changed; and an examination under a strong glass plainly shows that the "2" was originally "9", thus making the original date September 10, 1919, three days after Kratz's table of accelerators had been given to Weiss. This test was with new rubber, and not with shoddy, the ordinary stock of the plant. This has some slight significance in itself. Weiss in his testimony refers to this test as the first successful experiment with DPG.

After the meeting of the Chemical Society and the reading of the Kratz paper, a number of tests appear. Some of them are undated, it is true, and Weiss claims they were made in the Summer of 1919. Since they follow tests dated in October of 1919, and precede other tests dated in October, November and December, it is impossible to accept his testimony in this respect.

The testimony of Weiss has been supported by other witnesses in the plant. Their testimony is intended to establish completion of the discovery of DPG prior to Dr. Kratz's paper on September 6, 1919. Chief of these witnesses was M. H. Daniels, the immediate superior of Weiss in the Republic Rubber Company. He has testified that Weiss discussed DPG with him early in 1918, and that

he had knowledge that thereafter tests were being made of the substance. His exact knowledge of the progress of this investigation at any particular stage is by no means made plain by his testimony. Daniels attended the Chemical Society meeting at which the Kratz paper was read. Upon his return he delivered his notes of the Kratz paper to Weiss, and now alleges that he told Weiss that the paper confirmed their own findings as to DPG. But the exact nature of these findings does not clearly appear. That a complete discovery of the qualities of DPG had then been made, seems impossible under the surrounding circumstances. The test book actually showed only two inconclusive tests by Weiss. The Company during 1919 was mainly interested in TPG as an accelerator and was constructing a plant to manufacture it commercially; and it was investigating TPG as late as December 1, 1919, when Daniels wrote to one Stevens, a chemist of the Company, that he (Stevens) was spending "too much time on triphenyl. * * * Diphenyl is King pin now." The tests of DPG, subsequent to Kratz's paper, which were recorded, were quite numerous; but even so, the results were never imparted to the superior officer of Daniels, according to his testimony (see Clark, p.). Daniels has stated that he did impart information of the investigation to Mr. Clark in the summer of 1919, but that he also said: "I wasn't prepared to say how good it was." Still more convincing of the unreliability of the claim of complete discovery prior to September 6, 1919, is the admitted fact that the Republic Rubber Company never used DPG in the manufacture of any goods prior to the departure of Weiss on March 1, 1920. If a complete discovery of the powers of DPG had been made by Weiss, and was known to Daniels, it is almost inconceivable that not one trial of it should be made in actual manufacture.

In addition to these side-lights on the testimony of Weiss and his supporting witness, Daniels, the testimony discloses certain other matters that materially affect the weight of their testimony. Despite the fact that the Republic Rubber

Company never used DPG in making any articles, Daniels, in support of the patent application, made an affidavit wherein he stated:

> "These tests were also carried out in the compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods."

The manifest effect of the immediately foregoing was, at best, to create a false impression. In the same affidavit, a certain undated memorandum of test (copy attached to affidavit) was alleged to have been made "early in the year 1919." Daniels, in the instant case, said the entry was made late in the year 1919 or early in the year 1920. The context plainly shows the entry was not made early in 1919. This was a vital matter before the Patent Examiner, and whether such inaccuracies of statement are the result of carelessness or otherwise, the effect of them is to seriously affect the credit to be given the whole testimony.

Weiss' testimony in the instant case shows various contradictions of statements made in prior steps in the case, some in regard to material matters. Mere variation in recollection at different times is not always vital; but when by means of the variations the testimony becomes more favorable to the contentions of the witness with each successive delivery, the Court is required to scrutinize it with some care.

Certain other witnesses have been produced on behalf of the plaintiff. They were employees within the plant of the Republic Rubber Company, connected with the chemists only in the handling of tests. Having kept no records, and being unacquainted with the accelerator in the mix handled, it is not probable they would remember exact dates at the end of seven years. We feel that the circumstances, as well as our observation of the witnesses, preclude us from giving

great weight in the attempt to fix Weiss' discovery of DPG as prior to Kratz's disclosure.

The credible testimony shows that prior to September 7, 1919, the patentee, Weiss, made several tests with DPG; but those tests were so few in number and so inconclusive in results that no legitimate claim can be made to a knowledge of the superiority of DPG over TPG as an accelerator. We find as a fact, therefore, that Morris L. Weiss did not independently discover the efficacy of DPG as an accelerator of vulcanization prior to the delivery of the Kratz paper on September 6, 1919. But even had our finding in this respect been otherwise, the testimony discloses that not only had another disclosed the subject-matter of the patent to the world in advance of the patentee, but that others had also discovered the qualities of, and had used, DPG several years prior to the time claimed by the patentee as marking the beginning of his investigations.

In 1916, G. D. Kratz was a research chemist for the Norwalk Tire & Rubber Company. He had a degree in chemistry from Cornell University, and had been a rubber chemist for four years in 1916. In that year he prepared a quantity of DPG and established its efficacy as an accelerator by a number of tests. His investigation included a number of other accelerators, and a table was prepared by him which showed the comparative powers of the accelerators investigated. In this respect, his accomplishment was greater than that claimed by the patentee. While Kratz was engaged in this labor, his associates, Drs. Russell and Spence, were in touch with his work. They have testified to that labor and its results. As further confirmation a copy of Kratz's report to the Norwalk Company has been offered. In 1917 Kratz became Chief Chemist of the Falls Rubber Company. In 1917, he has testified, he used DPG in the manufacture of 300 tires, part of a consignment of 1000 tires sold. In 1918, Kratz repeated his tests of the various accelerators tested in 1916 at Norwalk. His reason for so doing was his desire to verify the previous results in a rubber compound which did not

contain zinc oxide, that material having been a part of the compound when the 1916 tests were made. These tests, with other labor necessary, furnished the foundation facts of the paper read September 6, 1919, and published in April of 1920.

It has been urged by counsel for the plaintiff that the testimony of Kratz as to the actual use of DPG in the manufacture of tires should be ignored, because uncorroborated, and points to the ignorance of subordinate employees of the Falls Rubber Company. There is some documentary evidence which tends to confirm this claim of use, but even if there were none we should not feel justified in rejecting it. To do so would be to impute wilful falsehood to Dr. Kratz, and neither his interest in this case nor his manner and appearance upon the stand was such as to furnish any foundation for that imputation. His knowledge of DPG and the general circumstances make the use of it as an accelerator quite probable.

It is further argued that Kratz's early investigations and discoveries were nothing more than abandoned experiments. The foundation of this claim seems to be based upon the misapprehension that no use of the idea other than actual manufacture or an application for a patent is an actual disclosure of it to the world and a reduction to practice. As a matter of fact the method of disclosure adopted by Kratz called the attention of rubber manufacturers to the discovery far more effectively than would have a patent application quietly filed in the Patent Office. As to what constitutes reduction to practice, see *Curtiss* v. *Janin*, 278 Fed. Rep. 454. Nor is the claim of abandonment to be established by pointing to the fact that no use of DPG followed Dr. Kratz's disclosure. In making use of such an argument counsel for plaintiff is attempting to bring the subject matter of this patent, to which plaintiff is not entitled, within the scope of another patent which does belong to it so far as the evidence of this case discloses. DPG was not used by rubber manufacturers after the Kratz disclosure, not because its efficacy was unknown or doubted, but because no method was known for its cheap

manufacture. Weiss devised a method which made possible its commercial use, and, so far as appears, accomplished something of great value. He filed an application for a patent upon this method some five months prior to his application for the patent in the instant case, and eventually was granted it. But disclosure of a method of cheap manufacture does not entitle a patentee to claim a monopoly in the use of an article whose qualities were disclosed by another. Commercial use is one thing, discovery another, although, it is true, such use may, under certain circumstances, throw light upon the novelty claimed for a patented device. Those reasons do not exist here, where the reason for non-use prior to plaintiff's method patent fully appears.

In reaching our conclusion that Morris L. Weiss was not the actual and independent inventor and discoverer of DPG as an accelerator, we have endeavored to consider the questions involved without being unduly affected by the action of other Courts in litigation upon the patent in suit; and, owing to the difference in opinion in such Courts, we trust we have been able to do so.

Let a decree be drawn in accordance with the finding of above opinion.

IN THE

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE THIRD CIRCUIT.

DOVAN CHEMICAL COMPANY,
Plaintiff Below,
Appellant,

vs.

CORONA CORD TIRE COMPANY,
Defendant Below,
Appellee.

No. 3470 October Term 1926.

On appeal from the District Court of the United States for the Western District of Pennsylvania.

Before BUFFINGTON, WOOLLEY and DAVIS, Circuit Judges.

FRALEY and PAUL, Solicitors for Appellant, JOHN W. DAVIS, JAMES M. NICELY, JULIAN S. WOOSTER and JAMES J. KENNEDY, of Counsel for Appellant.

DEAN S. EDMONDS, FRANK E. BARROWS and RAYMOND F. ADAMS, of Counsel for Appellee.

BUFFINGTON, Circuit Judge. This case concerns the acceleration of rubber vulcanization. As the patent here involved and the art to which it appertains has been set forth at length in an opinion reported at 292 Fed. Rep. 555, a case in the Second Circuit involving the same patent and

also in the exhaustive opinion of the Court below in this case, reported at 10 Fed. Rep. (2d) 598, we avoid repetition by referring thereto. The proofs show that Morris L. Weiss, the grantee of the patent here involved, was a chemist employed by a rubber company. During the course of his work and moved by a suggestion in Richter's Chemistry, Weiss, in March, 1918, conceived the idea that a well-known laboratory product, diphenylguanidine, known by the chemical symbol D. P. G., and listed by Richter as an accelerator, might be used in accelerating the vulcanization of rubber, and then so told Carlton, the chief chemist of the factory. The chemical properties of D. P. G. as a laboratory element, were of course known as an abstract truth, but no one prior to Weiss seems to have conceived and worked out any practical plan by which D. P. G.'s potential powers could be commercially used. The reason for this is plain for no one knew, or, for that matter, had tried to learn, how D. P. G. could be produced in such quantity as to make possible its commercial use. Having conceived the general idea and made at the factory where he was employed some recorded laboratory experimental work under various dates, Weiss took up the problem of trying out D. P. G. as a vulcanizer and of devising some way to make D. P. G. in such quantity that it could be practically used commercially. The problem was untried and difficult. He first set about making laboratory D. P. G. and in September, 1919, Weiss had produced five grams which by December he had tested with the ordinary rubber batches and found it powerfully accelerated, but the rubber product was overcured. However, he was encouraged by them and shortly thereafter his experiments resulted in a perfect cure which was recorded in an experimental book under date of February 10, 1919, a date which as we shall hereafter see is challenged as being changed to that date from September 10, 1919. Under date of February 21, 1919, another successful test, this time with a shoddy compound, was entered in the same book and another with shoddy on March 4, 1919. These experiments proved the

workable worth of D. P. G. as an accelerator in vulcanizing rubber, but Weiss stopped working further in that line as his supply of D. P. G. had been exhausted. He then turned his attention to discovering some way to make D. P. G. commercially. His efforts in that line resulted in his discovery disclosed and practically utilized in the patent in suit. We here note that he was told he could not get a patent for an accelerator, but, later on, finding he could patent his original discovery, he applied on November 12, 1921, for a patent thereon and on March 28, 1922, was granted the patent in suit, No. 1,411,231. This patent, regularly granted, under the authorities, is *prima facie* evidence of its validity and unless successfully challenged warrants a decree in this case as infringement is clear.

Such attack is here made and is based on two grounds, viz: first, denial of patentable invention and second, that, if patentable, Weiss was not the original inventor thereof.

Addressing ourselves to the question of patentable invention, we find ourselves in accord with the patent office's action in the grant of the patent. In the first place the worth of D. P. G. as an accelerator is evidenced in its use by the defendant, by the mass of testimony, array of counsel and earnest effort here very properly made to ensure its continued use by this litigation. Its use has been extensive in the art, it has reduced the time of vulcanization, obviated overcuring and increased the character and worth of the product. These elements, while not conclusive, are evidential of its worth in the art. Assuming for present purposes the *prima facies* of Weiss' patent stands, and the statement in his specification: "I have discovered that disubstituted guanidines particularly diphenylguanidine is particularly effective for this purpose" is true, and if he showed the world in addition how to make this product in commercial quantity in the rubber vulcanizing art, it would seem to us, and we so hold, that a claim, such for example as his eighth, viz: "The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcaniz-

ing agent and diphenylguanidine," was inventive in character and valid. In that regard we agree with Judge Manton's holding, when this patent was before him in the Second Circuit, that it involved invention, viz:

> "I am satisfied that the use of diphenylguanidine as in the plaintiff's process, involved invention. Using it advanced the art of rubber making. Its utility and the consequences which followed, fully support the real practical test of the sufficiency of an invention. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed. (Smith *vs.* Goodyear, 93 U. S. 486.) This substitution involved a new process of manufacture to develop a new use of the properties of diphenylguanidine and there was a new and useful result obtained. (See Smith *vs.* Goodyear, *supra;* Rumford Chemical Works *vs.* N. Y. Baking Powder Co., 134 Fed. 385; Genl. El. Co. *vs.* Hoskins Mfg. Co., 224 Fed. 464)."

The process then being new, useful and inventive in character, it remains to inquire whether the *prima facies* of inventorship which the patent vested in Weiss is overcome by proof of the standard the law requires, that someone else was the inventor thereof. Turning then to the patent to see what Weiss disclosed and, consequently, what alleged prediscoverers must convincingly prove they had discovered and disclosed before him, we note the specification states generally: "The object of my invention is to improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose. * * * I have discovered that di-substituted guanidines particularly diphenylguanidine is particularly effective for this purpose. * * * Down to the time of my researches in accelerators of this type, it was apparently not known that di-substituted guanidines were efficacious or useful as accelerators in vulcanizing, nor that this substance could be produced in sufficiently large quantities in

a substantially pure form, or at a sufficiently low cost to be available for this purpose."

The specification then states that in another patent, viz: Serial 482,143, he has disclosed "a process for producing and purifying diphenylguanidine in commercial quantities" and after disclosing fully how, in what proportions and under what heat conditions, the D. P. G. was to be used, Weiss set forth desirable results thereby obtained, viz:

> "It will therefore be appreciated that when using the accelerator according to my invention the vulcanization is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable, where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the bead-stock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness without danger of over-curing the softer or more elastic parts."

It will thus be seen that summarized Weiss' claim of invention was, first, that no one before him had known that D. P. G. was efficacious or *useful* as an accelerator in commercial vulcanizing; second, no one had known that D. P. G. could be produced in quantity, in pure quality or at a cost to permit its use in vulcanizing; third, that Weiss was the first to solve this second problem by his patent No. 482,143; fourth, that the solution of this second problem enabled him, for the first time in the rubber vulcanizing art, to commercially use D. P. G.

Without entering into details and a discussion of the proofs we may say they satisfy us that Weiss was the first to instruct the rubber art in this mode of rubber vulcanization and that up to his work the rubber art had made no use of D. P. G. in vulcanization and no one had therefore disclosed to the art or instructed it how D. P. G. could be practically produced or, of course, practically used. As showing the foremost advance, knowledge and practice in the rubber art in that regard, we take the exhaustive paper prepared by Dr. G. D. Kratz and his associates and read by him on September 2, 1919, at a meeting of The American Chemical Society in Philadelphia and published in April, 1920, in the Journal of Industrial & Engineering Chemistry. We feel justified in regarding this paper as evidencing not only the highest point of advance by the art in general but the highest point reached by the three men in their individual prior research and practical results attained. Here was a convention of the leading scientific minds of the rubber industry; here was an opportunity to disclose an invention of vast importance to that art, if it had been made, and to give the public instructions in a novel and untilled field, and in that field, barren of any attempt to use D. P. G. Therefore, to assert inventive priority and to foreclose all subsequent claimants of invention in that regard by there announcing and showing the thing had been done, was now disclosed and the art enabled to now use D. P. G., was an opportunity not to be neglected.

Assuming for present purposes that Dr. Kratz and his associates had conceived the idea of the practical and commercial use of D. P. G. in the rubber art, did this paper so state? Conceiving they had devised some way to make D. P. G. commercially, did the paper tell the art how it could be done? That the paper did not give such information is clear. A contemporaneous report of the meeting and the paper in question made to his company by Williams, a chemical representative of a rubber company, who attended the meeting, may be taken as illustrative of the effect it made

on the most highly skilled minds in the art, for after giving an analysis of what the paper meant to him, in which we find no such disclosure as Weiss made in his patent, Williams adds: "The symposium on the action of accelerators which followed was unimportant as every one seemed to try to conceal all he knew on the subject, but obtained all the information possible from others". And indeed that withholding of information from the rubber art, and not disclosure of a workable advance was the very purpose of the paper of the authors and was testified to by one of their number who said:

> "We absolutely had no intention of giving any information which any other company or competitor could transpose directly for *practical* purposes. Our idea, however, did give enough information so that any reputable chemist would be guided by the information in the paper.
>
> Q. Guided to the extent of being put on inquiry, to find out for himself anything you did not say—is that right?
>
> A. Guided to the extent of stimulating investigation along the same lines with which we were pioneering.
>
> Q. And without telling him what to investigate?
>
> A. No, sir. We gave him two tables of what to investigate.
>
> Q. But, I mean, you did not tell him any specific substance to investigate?
>
> A. Well, we gave him two tables of substances, which we pointed out were excellent accelerators.
>
> Q. And he could take his choice from any one of the substances mentioned in the two tables?
>
> A. Absolutely.
>
> Q. And go on investigating for himself?
>
> A. Yes, sir, because there is no one accelerator of universal application or universal quality."

And this estimate by Dr. Kratz of the purpose of the paper, namely, an invitation to experimental research, is evidenced by what influence the paper had in the case of Weiss personally. Daniels, who was Weiss' chief, attended the meeting in Philadelphia and took notes of the tables in the paper,

and on his return, as he testified, he did "immediately tell Weiss that the statements made in the paper read by said Kratz confirmed our experience with D. P. G. as to accelerating, and that we should continue to work on that substance and develop a commercial process if possible."

It will thus appear that the paper of Kratz and his associates had no effect on the working art. No one made any practical use of it. No one in the art selected D. P. G. from the several accelerators named in its tables and used it in the vulcanization of rubber. No special emphasis was laid on D. P. G. in comparison with other substances so named and it is quite evident that if advance in the art had stopped with the Philadelphia paper the art would not have had the information and advance disclosed by Weiss in his patent specification and would not have made the successful advance which followed Weiss' disclosure. Such being the negative results produced by the paper, we cannot accede to the proposition that its theoretical statements, valuable as they were, forestalled or even fore-shadowed the clearcut, practical conception which Weiss then purposed and which he later practically worked out, namely, the successful pioneer making of D. P. G. commercially, and when made successfully and pioneeringly using it in the rubber vulcanizing art.

In arriving at the conclusion that the *prima facies* of Weiss' patent has not been met, we deem it proper to say that while we have not discussed, we have not overlooked, the many other matters disclosed in the proofs and argued by counsel. We have only discussed what we regard as its decisive features but we deem it proper to say, without discussing the evidence, we have reached the conclusion that the time date of entry by Weiss in the experiment book was February 10, 1919, as contended by the plaintiff and not September 10, 1919, as contended for the defendant. We deem it proper to say also that we have not discussed the technical contents of the Philadelphia paper for two reasons; first, our technical inability to do so; and second, the need-

lessness of doing so, had we been able, because for the purposes of this case, we have the evidence of its reader, uncontradicted by his associates, that its purpose was not to disclose a useful, workable process, but on the contrary not to do so.

In reaching the conclusion we have we regret to find ourselves at variance with those reached by two Circuit Judges of the Second Circuit, reported at 292 Fed. Rep. 555, heretofore referred to, but such regrettable divergence of view is lessened by the fact that the views of two other Circuit Judges of that Circuit are in accord with our own.

So holding, the decree entered below will therefore be reversed and before the mandate goes down an opportunity will be given counsel to agree as to its form.

WOOLLEY, *Circuit Judge*, dissents.

FILED
DEC 21 1927
CHARLES ELMORE CROPL
CLERI

Supreme Court of the United States,

OCTOBER TERM, 1927.

No. [redacted] 182

CORONA CORD TIRE COMPANY,

Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,

Respondent.

BRIEF FOR PETITIONER.

DEAN S. EDMONDS,
WILLIAM H. DAVIS,
FRANK E. BARROWS,
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The Evening Post Job Printing Office, Inc., 154 Fulton St., New York, N. Y.

BRIEF FOR PETITIONER.

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The function of vulcanization always has been to improve the physical properties of rubber, and it has long been known that certain substances called "accelerators" both hastened the process of vulcanization and improved the quality of the product.

THE PATENT IN SUIT 14

The patent in suit relates simply to the use of DPG (diphenylguanidine) in vulcanization and is not concerned with any process of making DPG. There is another Weiss patent owned by plaintiff relating to a method of making DPG and that other patent is not in suit.

THE PATENTED IDEA 15

The patent in suit discloses only one idea, that DPG is a powerful accelerator, more powerful than TPG (triphenylguandine).

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FIRST DEFENSE 18

The Weiss patent is invalid because of publication of the invention in the Kratz paper, plaintiff's effort to prove prior invention by Weiss having failed.

THE KRATZ PAPER..... 18

The Kratz paper is a compete disclosure of the utility of DPG as an accelerator, and gives more useful and more accurately stated information about it than the patent in suit.

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The trial court held that "Weiss's testimony in the instant case shows various statements made in prior steps in the case, some in regard to material matters" and that "the circumstances, as well as our observation of the witnesses, preclude us from giving great weight to the attempt to fix Weiss's discovery of DPG as prior to Kratz's disclosure"; and in the absence of manifest error an appellate court should not go behind a ruling of the trial court on this issue.

CREDIBILITY OF WEISS AND HIS CORROBORATING WITNESSES 39

Although Weiss should have recorded any tests he made while an employee of the Republic Company, the only dated record produced consists of three tests; Weiss admits he altered the date of one of these, and the other two demonstrate no superiority of DPG over TPG. Weiss

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and his principal corroborating witnesses, Daniels and Carlton, are unworthy of belief. The testimony of Nellen and Halliday is worthless as corroboration.

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Any work done by Weiss with DPG prior to the Kratz paper was wholly inconclusive. This is stated by plaintiff's witness Daniels and is demonstrated by the course of work on accelerators at the Republic Company and the effect of the Kratz paper on that work, and by the tests with DPG which were recorded.

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In 1917 Kratz made a special lot of tubes and employed DPG as an accelerator in 300 of them and these tubes were sold in the regular course of business by the Falls Company. At that time, Kratz did not continue to use DPG because a sufficient supply of it was not available at a sufficiently low price.

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KRATZ'S DPG INVESTIGATIONS AT THE FALLS COMPANY 73

After making the tubes, Kratz repeated his Norwalk tests using another standard compound and obtained the results given in his paper. Table 1 of the paper listing these results corresponds in all respects with the results reported to the Norwalk Company.

PRIOR INVENTION AND PRIOR KNOWLEDGE..... 74

Whatever invention there was in ascertaining the utility of DPG as an accelerator was completed by Kratz at Norwalk in 1916. Furthermore, there was knowledge of the alleged invention by Kratz and his associates at Norwalk prior to the earliest date claimed by Weiss. Therefore, anyone who made the invention thereafter was not the first inventor, and if a patentee is not the first inventor his patent is void.

SECRECY AND ABANDONMENT 80

Plaintiff's charge of secrecy is unsound in view of the dissemination of Kratz's information with respect to DPG among his associates in at least two Rubber Companies and in view of the reading and publication of his paper. The information contained in the disclosure of the Weiss Patent is less useful for practical purposes than the information contained in the Kratz paper. If there was any abandonment by Kratz, it was abandonment of a completed invention to the public.

THIRD DEFENSE 87

The Weiss Patent is invalid because of the prior use of DPG by Kratz and the Falls Rubber Company.

The tubes made by Kratz in 1917 constitute a prior public use of the alleged invention of the

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patent in suit which invalidates the patent. The evidence is entirely sufficient to establish this prior public use and one instance of prior use is sufficient.

FOURTH DEFENSE 93

Weiss is not an original inventor.

The only record evidence produced on behalf of Weiss contains a record of an earlier test with DPG made by Baldwin prior to Weiss's employment by the Republic Company. Baldwin identified this record, and is corroborated by Brill, Clark and Haring. Baldwin could have and probably did obtain his DPG from Eimer and Amend. Weiss made no claim to originality of the use of DPG at various times when he would have done so if he had believed himself the originator.

FIFTH DEFENSE 102

The Weiss patent does not disclose a patentable invention.

Various guanidine derivatives had been known as accelerators and the guanidines as a group and triphenylguanidine specifically were disclosed to Weiss by Carlton. Diphenylguanidine is the next most closely related member to triphenylguanidine and is grouped with it in chemical text books. It was a natural step, therefore, knowing that the guanidines as a group were accelerators and that triphenylguanidine was an accelerator, to use the closely related member DPG.

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SIXTH DEFENSE 108

Claims 1, 5 and 9 of the Weiss patent are invalid by reason of special matters applying to them only.

These claims purport to cover the use of all "di-substituted guanidines", a class including DPG. These claims are invalid because the subject matter thereof is disclosed in a magazine article published more than two years before the patent in suit was applied for. These claims are invalid because they are broader than any invention made by Weiss. These claims are invalid because there are various di-substituted guanidines which are not accelerators.

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Credit for the commercial success of DPG as an accelerator cannot properly be ascribed to the alleged invention of the Weiss patent in suit; and if any part or all of it is to be ascribed to the patent for Weiss's method of making DPG, that is a matter of no consequence in this litigation.

THE CONFLICTING OPINIONS 120

The fundamental error of the opinions holding the Weiss patent valid resides in the confusing and combining of the two patents granted to Weiss, only one of which is in suit, and attributing to the patent in suit a commercial success which was the outgrowth of the second patent which is not in suit.

The basis for the rulings of this Court in *Coffin* vs. *Ogden* and *Milburn* vs. *Davis-Bournonville* is that a patent cannot be valid if the invention thereof was previously known, and the alleged invention of the patent in suit was previously known.

APPENDIX.

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Supreme Court of the United States.

OCTOBER TERM, 1927.

No. 180

CORONA CORD TIRE COMPANY,
Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

BRIEF FOR PETITIONER.

TO THE HONORABLE THE JUDGES OF THE SUPREME COURT OF THE UNITED STATES:

This suit presents a single issue, *i. e.*, the validity of Letters Patent No. 1,411,231, granted March 28, 1922, to the respondent as assignee of Morris L. Weiss (Vol. II, p. 718).

Jurisdiction of this Court results from the issuance of a writ of *certiorari* to the United States Circuit Court of Appeals for the Third Circuit (Vol. II, p. 1039). The writ was issued because of conflicting decisions of Circuit Courts of Appeals.

This is the second suit in which the validity of the Weiss patent has been adjudicated. The first was brought by the respondent, Dovan Chemical Corporation, against National Aniline & Chemical Company, Inc., in the District Court for the Southern District of New York. The District Court sustained the validity of the patent, (opinion not re-

ported) and on appeal the Circuit Court of Appeals for the Second Circuit, with one member dissenting, held the patent invalid (292 Fed. 555). A petition for a writ of *certiorari* was denied by this Court (263 U. S. 714).

Thereupon respondent brought this suit against Corona Cord Tire Company in the District Court for the Western District of Pennsylvania. That Court held the patent invalid (10 Fed. 2d, 598) and on appeal the Circuit Court of Appeals for the Third Circuit, also with one member dissenting, held the patent valid (16 Fed. 2d, 419).

For convenience and brevity, the first suit against the National Aniline & Chemical Company, Inc., will be referred to as the *National* suit, and this present suit against the Corona Cord Tire Company as the *Corona* suit, and the parties to this suit will be designated plaintiff and defendant.

The Weiss patent in suit relates to the vulcanization of rubber. Vulcanizing consists in mixing a small amount of sulphur with rubber and subjecting the mixture to heat for a period of time, during which chemical combination of the rubber and sulphur takes place. If a chemical of a kind known as an "accelerator" be introduced into the mixture along with the rubber and sulphur, the process of vulcanization proceeds more rapidly and the product is of superior quality.

The patent in suit states that a particular chemical substance known as "di-phenyl-guanidine" is a better accelerator than the ones previously used and it claims a monopoly in the use of that particular chemical in rubber vulcanization.

Defendant maintains that the patent in suit is invalid in its entirety,

1. Because of prior publication of the efficacy of diphenylguanidine as an accelerator in a paper prepared by Dr. George D. Kratz and two others, and read by Dr. Kratz before a meeting of the American Chemical Society.

2. Because of prior invention by Dr. Kratz of the use of diphenylguanidine as an accelerator, if that was an invention

at all, and prior knowledge thereof by Dr. Kratz and Dr. William F. Russell and their associates.

3. Because of prior use of diphenylguanidine as an accelerator by Dr. Kratz and the Falls Rubber Company.

4. Because the idea of using diphenylguanidine as an accelerator was not an original conception of the patentee, and

5. Because the disclosure of the patent does not constitute patentable invention.

These matters all relate to the validity of the whole patent. In addition, there are defenses applicable only to certain broadly worded claims of the patent to which we shall refer later.

Summary of Defendant's Argument.

Defendant's argument that the Weiss patent in suit should be held to be invalid in its entirety is based upon the following propositions:

1. Long prior to the filing of the application for the patent in suit, the invention described and claimed in the patent was disclosed in a paper read by Dr. George D. Kratz before a meeting of the American Chemical Society at Philadelphia, Pa.

The Kratz paper is a complete disclosure of the superior accelerating value of the chemical in question. In particular, the paper expresses that superiority by comparison with the identical accelerator the patent in suit refers to for that purpose. In addition to the contents of the paper itself, there are two most persuasive reasons for accepting the paper as a full disclosure of the patented idea. First, the paper was cited by the Patent Office as a basis for rejecting the application for the patent in suit, and in answer to that rejection no suggestion was made by the applicant that the paper was in any respect deficient as a disclosure of the invention claimed. Second, on two occasions when the patentee of the patent in

suit was soliciting employment long prior to applying for his patent, he referred to the Kratz paper as authority for the value of the accelerator and made no suggestion that the idea of using it originated with him.

The patent in suit was applied for November 12, 1921. The Kratz paper was published in a technical magazine having wide distribution in April, 1920, about one and one-half years before the filing of the Weiss application. Thus the paper is not, in itself, a complete bar to the validity of the patent, for, under the Statute, a patent is invalid when the invention has been "described in any printed publication * * * more than two years prior to his application" (Rev. Stat. Sec. 4886; U. S. C., Tit. 35, Sec. 31). Because of that, the effect of the paper as an anticipation could be overcome by plaintiff by showing that Weiss made the invention before the publication date of the paper. But the paper was read to an assembly of rubber chemists at a meeting of the American Chemical Society in September, 1919, so the invention was then disclosed by Kratz and was then known to him and then became known to those who heard him read his paper. Therefore, to establish priority, it is necessary for plaintiff to carry Weiss's date of invention back prior to September, 1919, to antedate this prior invention and prior knowledge.

When the Patent Office cited this Kratz paper as a basis for rejecting the claims presented, the only reply was an effort to show that the invention was made by the applicant prior to the reading of the paper. The law imposes a heavy burden on an applicant who attempts to carry his date of invention back of an anticipating reference; to succeed, he must establish his contention by evidence "so cogent as to leave no doubt in the mind of the Court". Also, the greater the period of time he attempts to carry his date back, the stronger must his evidence be, and in this instance he was attempting to carry his date back nearly three years. In the *ex parte* proceedings in the Patent Office, the affidavits offered to prove the early date were accepted as sufficient and the patent was granted. In this suit, the same effort has been

made to carry the patentee's date of invention back of the Kratz paper. That effort should be held to have failed, and because of its failure the Kratz paper in itself requires that the patent in suit be invalidated.

That effort should be held to have failed because the testimony offered is so filled with discrepancies as to make it wholly unreliable. The District Court Judge, who heard and saw the witnesses for plaintiff on this point, held them to be unworthy of belief, and established practice requires that an appellate court shall accept and uphold such a finding of fact unless palpable error is apparent. This Court has frequently characterized such a finding of fact by a trial court on the credibility of witnesses as "unassailable". But even if such a finding were less potent, the great weight which common sense dictates should be attached to it should be considered in conjunction with the rule as to the character of proof required of a plaintiff attempting to "anticipate an anticipation". It cannot be that, in the absence of manifest error, a plaintiff's claim to an early date of invention is so proven as to "leave no doubt in the mind of the Court" when the Judge of the lower Court who heard the witnesses produced to prove it and observed their demeanor, concluded that their testimony could not be believed and said so in his opinion.

Furthermore, if independent examination of the testimony offered by plaintiff were now made, it would lead to the same conclusion as that reached by the District Court Judge, namely, that it precludes "giving great weight to the attempt to fix Weiss's discovery of DPG as prior to Kratz's disclosure".

Finally, if all of plaintiff's testimony which is supported by documentary evidence were accepted at its face value, it would be insufficient to establish for the patentee a date of invention prior to the Kratz paper, because all the patentee claims to have done before the Kratz paper was inconclusive, and would have led to nothing of value but for the new impetus derived from the paper.

2. If all plaintiff's claims as to what was done by its patentee and when he did it were assumed to have been adequately proven, and the patent in suit were given the benefit of the earliest date of invention claimed for it, still the patent should be held to be invalid because the patented invention had previously been conceived by Dr. Kratz, and disclosed by him to others, and utilized by him to the point of demonstrating its value. Records of Dr. Kratz's work are before the Court. Their authenticity has not been questioned and they are directly comparable to, and far more definite and informative than the records produced in behalf of the patentee. Also, disclosure by Dr. Kratz to others has been definitely proven and has not been questioned. Therefore, the patentee was not the first inventor and the idea patented was not new. The patentee was not the first inventor because at an earlier date the invention had been made by another; and the invention was not new because that other had disclosed it and made permanent written records of it.

It is futile to say the invention was maintained in secrecy by Dr. Kratz. There is no evidence that effort was made to maintain it in secrecy at the company where Dr. Kratz was employed; and, when he left that concern and entered the employ of another rubber manufacturing company, knowledge of the invention went with him to his new employer and stayed behind him with his old one, that is, with his co-workers who remained in the employ of his old company and in the official records he prepared for that company. Also, publication is the very antithesis of secrecy and Dr. Kratz published the invention in the most effective way such an idea can be published.

It is equally futile to say the invention was abandoned by Dr. Kratz. If he and his associates and the company by which they were employed had done nothing more after the demonstration of the value of the invention, there would be no abandonment which would permit some subsequent inventor to obtain a patent monopoly in the use of the idea. The act of invention had been completed

in all respects. So the only possible abandonment would be abandonment to the public, defeating all efforts of all persons to monopolize the idea at any time thereafter. But the fact is that there was no abandonment of the idea of any kind whatever up to the time when Dr. Kratz gave it to the public in his paper. He made comprehensive records of the idea and left them in the files of the manufacturing company by which he was employed, he made use of the idea in commercial work on a small scale, and he made check-up experiments in connection with the preparation of his paper, and these, together with the writing, reading and publication of the paper, are wholly inconsistent with the idea of abandonment.

3. The patent in suit should be held invalid because of a prior use of the patented idea in the commercial manufacture of rubber articles prior to the earliest date claimed in behalf of the patentee. This prior use was by Dr. Kratz, the author of the paper above referred to, and the Falls Rubber Company with which he was then connected. That company received an order for certain rubber tubes, and, having some of the chemical in question available for use, Dr. Kratz decided to use it and did use it until the amount at hand was exhausted. The chemical was put into the rubber mix by Dr. Kratz himself and no one associated with him knew he had done so. Because of that, there was no available direct corroboration of his testimony with respect to this prior use; indirect corroboration is presented by numerous documents and depositions but direct corroboration was unobtainable. The question thus presented is whether or not this evidence, the limitations of which are and always have been recognized, leads to belief that the prior use actually occurred. The Judge of the District Court who heard and saw Dr. Kratz believed that it did and said so, and we know of no reason why anyone should not believe it. It is true that the law requires convincing proof of a prior use to warrant invalidating a patent, but there is no mathematical

rule as to what constitutes a sufficiency of evidence, and if the evidence submitted, whatever its character and the extent of the corroboration, leads to belief extending beyond all reasonable doubt that the use occurred, then the patent must be held to be invalid for lack of novelty. That is the situation presented here. There is Kratz's clear, direct and comprehensive testimony of what he did and how and when he did it, and in addition there is a wealth of surrounding circumstance set forth in testimony and contemporaneous documents, and the effect of the aggregate of this evidence is to compel belief that the use occurred as alleged.

4. The idea of using the patented accelerator did not originate with the patentee. The very record which is offered in the patentee's behalf in the effort to prove his date of invention shows that the patented idea was conceived by or known to another who recorded knowledge of it in a place where the patentee must have seen it. This is of special importance in connection with the credibility of the patentee, but in addition it establishes that the patented idea was not an original conception of the patentee, for which reason also the patent should be held to be invalid.

5. The patented idea does not involve patentable invention and the patent in suit should be held invalid for that reason. The patented chemical is as closely related as is possible to another substance which had been used as an accelerator before, and the use of which was known to the patentee and mentioned by him in his patent. The two substances are very much the same in name, utility and chemical composition, so much so that in chemical books where both are mentioned, one appears immediately after the other. In this situation, the serviceability of one of these two substances as an accelerator of rubber vulcanization being known, no inventive act was involved in the thought that the other of the two closely related substances might also be an accelerator. Any chemist knowing the two substances to be so closely

related and knowing that one of them was an accelerator, would have assumed that the other was also; and on trying it, he would have found that his assumption was correct; and neither of the two acts or both of them together would have involved patentable invention.

These are the propositions upon which rests the argument of invalidity of the patent in suit in its entirety. Later we shall point out certain matters which relate only to particular broadly phrased claims. These several propositions will now be discussed in detail.

Vulcanization.

Consideration and decision of this suit requires dealing with various chemical substances whose names are seldom mentioned outside the art of vulcanizing rubber, but they do not require consideration or application of any of the abstruse principles of chemistry. It is necessary only that the statement of certain undisputed facts about these chemicals be accepted. Chief among these is that there are certain chemical substances which may be introduced into a mixture of rubber and sulphur, and which, when that mixture is heated to vulcanize the rubber, serve to hasten the process of vulcanization. Because of that capacity, such substances are called "accelerators."

The patent in suit (Vol. II, p. 718) purports to cover broadly the use of one such substance, namely, a chemical called diphenylguanidine, and for brevity sake designated throughout this litigation as DPG. As to four of its 12 claims, the patent purports to be of even broader scope in the respect that it covers the use as accelerators of DPG and all other substances that fall within a class known as di-substituted guanidines. This single idea of using DPG or some other di-substituted guanidine as an accelerator of rubber vulcanization is stated simply and directly in the claims

of the patent, and the single issue presented by this suit is whether or not that idea constituted an invention, and if so, an invention which was the contribution of the patentee Weiss.

The process of vulcanizing is old and well known; its present high state of development represents an evolution of about 80 years. The function of vulcanization is and always has been to improve the physical properties of the rubber, primarily to increase its strength, elasticity and wearing qualities. Practically all rubber, whatever its use, is vulcanized (Vol. I, p. 36, Q. 5).

Vulcanization, or "cure" as it is sometimes called, involves mixing sulphur with rubber and then subjecting the mixture to heat. The amount of sulphur in the mixture is small, as for instance 4 to 10 parts of sulphur to 100 parts of rubber. The remainder of the mixture may be all rubber or it may be partly rubber and partly other ingredients such as fillers and pigments, the other ingredient used most widely being zinc-oxide. For instance, in the manufacture of automobile tires a considerable proportion of zinc-oxide is used; a very common proportion would be fifty parts of rubber, forty-five parts zinc-oxide and five parts sulphur, and this mixture would be vulcanized or cured by subjecting it to heat to make the vulcanized rubber of commerce.

It will be apparent that molds have to be provided for giving the desired form to the vulcanized rubber articles, and that steam has to be supplied for heating the molds and the rubber composition therein during the process of vulcanizing; therefore, the time required for carrying out the process is of importance, for if the time could be reduced by one-half the out-put of a given equipment would be doubled.

Many years ago it was found that the chemical reaction which takes place between sulphur and rubber would be hastened by the presence in the mixture of a substance of the class of what have since become known as accelerators (Vol. I, p. 36-7). The amount of the accelerator employed is small; three per cent. for instance would be a large amount, and a

fraction of one per cent. is quite usual (Vol. I, p. 78, Q. 147-151.). In the commercial manufacture of vulcanized rubber articles, accelerators have been commonly used for generations. Various substances known to chemists have been found to be serviceable as accelerators in different degrees, and one or another of these has been used in practically all manufacturing plants, the particular ones used being dependent upon the judgment of the chief chemist of the plant and the particular rubber articles to be produced. At first, inorganic substances, such as lime and litharge, were employed, but a dozen or more years ago it was found that certain organic substances were even more powerful, or more "active" as is usually said, and in recent years these organic substances have been used almost exclusively (Vol. I, p. 37).

The sole purpose of vulcanization is and always has been to improve physical properties; without vulcanization, rubber would not be useful for most purposes. But the heat to which the rubber mixture is subjected during vulcanization has certain bad effects upon the rubber and the longer the time of the cure the greater the injury; so an accelerator which speeds up the cure and therefore makes it possible to reduce the time during which the mixture is subjected to heat, reduces the deteriorating effect of the heat on the rubber and leads to the production of rubber having greater strength, elasticity and wearing qualities. Thus the primary function of an accelerator is and always has been to shorten the time required for the cure and also to improve the quality of the product. This is embodied in a definition of an accelerator which has been offered by plaintiff and which we adopt, namely,

> "A vulcanization accelerator is a material added to the mixture which hastens the process of cure and improves the elasticity, tensile strength, and other desirable commercial qualities of the finished product."

The nature of the action which takes place was explained by one of defendant's witnesses as follows (Vol. I, p. 533, Q. 11):

> "If the activity of the accelerator is used to cut down the time, you will get a better product. This is ordinarily

considered to be due to this fact; it is quite commonly accepted that vulcanization consists of two different things going on at the same time—the rubber is being broken down or depolymerized by the heat and is being built up or polymerized by the accelerating action, and the net result is what we know as the vulcanized product.

12 Q. Has this bettering of the product through the use of accelerators been known and recognized by workers in the rubber art for some time?

A. Yes, it has been known and recognized, and developed, practically since the beginning of the use of organic accelerators."

The same thing was stated by plaintiff's witness, Carlton, who said (Vol. I, p. 96, Q. 33-4) it was well known that the greater the length of time a compound is cured, other things remaining equal, the lower are the physical properties of the stock at optimum cure, and that the reason for this is that when "the compound is subjected to heat for a less length of time, the physical properties are better" and that "heat itself has a deteriorating effect upon rubber."

This witness said these things were well known and were taught in the colleges long before the dates we are concerned with here (Vol. I, p. 96-7, Q. 33-37).*

So it is manifest that the proper use of an accelerator not only reduces the time required for the cure but also produces a better product, and, within some limits, the greater the activity or power of a particular accelerator, the more may the time of the cure be reduced until the point of maximum physical properties is reached.

Of course there are other factors to be considered, such as the temperature of the cure and the amount of the accelerator used. The production of the high temperature required for vulcanization during the period of the cure is a considerable item of expense, and the cost of the accelerator itself is also an important item. The greater accelerating power of

* Other references to the same purport are:

Vol. I, p. 37, Q. 5; p. 76-7, Q. 136-143; Ex. RR, Vol. II, p. 989; Ex. PP, Vol. II, p. 988; Ex. OO, Vol. II, p. 985.

some particular substance may be utilized to reduce the *time* of the cure, or to reduce the *temperature* of the cure, or to reduce the *amount* of the accelerator employed, all three of these reductions being very desirable; or it may be utilized to permit reduction to a less degree of any two or all three of them (Vol. I, p. 532-3, Q. 9-11).

In practice, it is usual to distribute the effect of the accelerator used in a rubber batch with respect to all three of these items, *i. e.,* time, temperature and quantity. The particular way in which this is done is determined individually by every manufacturer for each one of his accelerators and each one of his various products. It is determined by a series of tests in which one factor after another is varied progressively until the results desired are obtained. Each of these tests involves vulcanizing a small piece of rubber, usually termed a "test-slab", and then testing that slab in a suitable testing machine. Every rubber factory has a laboratory equipped with vulcanizing presses and testing machines and the work of making these test-slabs with varying formulæ and testing the products goes on continually. It is done not only to develop new formulæ for new products but also to keep adequate check on production in accordance with a standard formula (Vol. I, p. 74-5, Q. 121-9; p. 77-8, Q. 143-6; p. 84, Q. 188; p. 347, Q. 41-2). This common practice should be borne in mind because so much of the work to be discussed herein involved the production of such slabs in the laboratories of rubber manufacturing companies.

For instance, the present day use of DPG as an accelerator in a rubber manufacturing plant requires the constant cooperation and supervision of a laboratory in that plant; the laboratory has to go through a series of tests for each of its various products to determine upon the formula to be used so that each product will have the particular qualities desired, for rubber products vary in quality over an exceedingly wide range, as for instance from strong inelastic automobile tires to relatively frail but highly elastic articles like inner tubes. Also, once a suitable formula is determined, the work of the laboratory in making test-slabs goes on continu-

ally by way of controlling the operation of the factory and thus maintaining the standard of the product.

For upwards of ten years prior to the patent in suit, organic substances had been in common use as accelerators, supplanting the less active inorganic substances to a large extent. The organic substances which were perhaps best known were aniline and thiocarbanilide; the latter substance is also called diphenylthiourea and it is commonly referred to as "thio". Another substance which came into wide use many years before the patent in suit is hexamethylenetetramine, usually abbreviated as "hexa". Still another organic substance which had been used to some extent is triphenylguanidine, usually called "TPG".

The Patent in Suit.

The patent in suit purports to cover the discovery that another organic substance, known for generations in the science of chemistry, is serviceable as an accelerator, and that this other substance is a better accelerator than the substances previously used. This substance is diphenylguanidine, commonly called "DPG".

The patent refers generally to the well-known vulcanization process and the common commercial use of various accelerators including TPG in the practice of that process. Then it states that DPG is a good accelerator and asserts that certain advantages are attained by its use. Then it gives a formula for a rubber compound in which DPG is the accelerator. The proportions indicated for the rubber, zinc-oxide and sulphur are usual ones; the only respect in which the process of vulcanization outlined differs from the procedure then in common commercial use is in the particular accelerator used (*i. e.* DPG); and the time of the cure is short because of the activity of DPG as an accelerator and the relatively large amount of it (2%) used.

It should be noted particularly, to avoid confusion, that the patent in suit is in no way concerned with the manufac-

ture of DPG or the cost of manufacturing it. DPG has been known as a chemical substance for generations and the text-books of chemistry have contained directions as to how to make it. This is stated to be the fact in the Weiss patent, beginning in line 31 on page 1 (Vol. II, p. 718). But no one had had occasion to make it in quantity or to consider how it could be made at low cost. This patentee, Weiss, claims to have invented a process of making DPG at low cost and has been granted another patent for his process, (Ex. QQ, Vol. II, p. 1002, side folio 297) but that is in no way concerned with the patent here in suit. Of course DPG would never have been used commercially as an accelerator if it could not have been produced in quantity at low cost; but that has no bearing in this suit for we are concerned here only with the perception and announcement that DPG, however made, is an accelerator of relatively high activity, that is, higher than the accelerators previously in use, such as TPG, hexa and thio.

The Patented Idea.

The Weiss patent in suit discloses one idea and only one. All the rest of the description in the patent is either inaccurate or only the statement of what was known to all rubber chemists. That one idea is that DPG is an accelerator of great activity, of an activity greater than TPG. It is stated in the three lines at the bottom of the first column of the first page of the patent as follows:

> "I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine."

The accuracy of this statement that there is but this one idea disclosed in the patent should be apparent from what we have said above of the prior knowledge and prior practices of the rubber industry. Also, this same statement, in different words, was made by the Patent Office Examiner who passed upon the application for the Weiss patent, and

by the Circuit Court of Appeals of the Second Circuit in the *National* suit.

The Patent Office Examiner said, in a letter dated February 20, 1922, appearing in the File Wrapper of the Weiss patent, (Ex. H, Vol. II, p. 897) that Weiss's specification "is no more than a broad disclosure of the use" of diphenylguanidine "without disclosing any details other than that usually employed with accelerators of this class."

The Court of Appeals of the Second Circuit reviewed these Patent Office proceedings in the *National* case and expressed its agreement with the Examiner in the remark above quoted. Also, the Court said (292 Fed. 557):

> "What Weiss invented, he tells in his specification, thus,—'I have found that DPG is much more powerful and efficatious as an accelerator in vulcanization than TPG'; and nothing in plaintiff's evidence enlarges, improves or contradicts this simple statement. The claims, too, when the increment of using the phrase 'disubstituted guanidines', instead of DPG, is disregarded, mean substantially just what Weiss swore to; and the whole application might be condensed into one sentence, —'I claim the use of DPG as an accelerator, because I was the first person who observed its efficacy for that purpose."

Beyond the statement of this one idea that DPG is an active accelerator, the specification of the Weiss patent consists of general statements about the quality of the product obtained by the use of DPG, a formula for a compound containing DPG, and directions to vulcanize such a compound in accordance with the usual process of vulcanization. The formula given is one which was commonly used with various accelerators; it is not a good formula to use when DPG is the accelerator and present-day commercial practice is widely different from it. The amount of sulphur and the amount of DPG specified are both too large, as witnesses on both sides have agreed; the present commercial practice is to use about one-half of one per cent. of DPG (Vol. I, p. 78, Q. 148; p. 536, Q. 16), instead of the 2% recommended by the patent where

the formula calls for one part of DPG to fifty parts of rubber. The defendant in this case used about two-thirds of one per cent. as appears in the stipulation forming Exhibit 1 (Vol. I, p. 34).

As to the general directions given in the patent for vulcanizing the mixture compounded in accordance with the formula stated, these differ in no respect from the standard practice of many years past; no one has ever suggested that they involved any novelty.

As to the assertion of improved physical properties of the product obtained, these are in accord with the known general principle above discussed, namely, that a superior product results from the use of an accelerator, or a more active accelerator, because then the time during which the mixture is subjected to the vulcanizing heat is reduced. When these assertions are considered specifically as they are stated in the patent, they amount to nothing more than reiteration that DPG is an active accelerator, and that, generally speaking, higher activity of the accelerator makes better rubber products.

It must be evident, therefore, that the patent contains nothing that purports to be a disclosure of a novel idea beyond the statement that DPG is a superior accelerator, that is, the statement at the bottom of the first column of the patent reading:

> "I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine".

As stated by the Second Circuit Court of Appeals, in the *National* case, the whole patent could be expressed in one sentence reading (292 Fed. 557):

> "I claim the use of diphenylguanidine as an accelerator because I was the first person to observe its efficacy for that purpose."

Having thus fixed definitely the asserted novelty of the Weiss patent in suit, the defenses heretofore stated may be discussed in detail.

FIRST DEFENSE.

The Weiss patent is invalid because of publication of the invention in the Kratz paper, plaintiff's effort to prove prior invention by Weiss having failed.

The Kratz Paper.

This paper was the joint production of Messrs. Kratz, Flower and Coolidge, employees of the Falls Rubber Company, a rubber manufacturing company located at Cuyahoga Falls, near Akron, Ohio. It was read by Dr. Kratz before the Rubber Division of the American Chemical Society at a meeting held at Philadelphia from September 2 to 6, 1919. An abstract of the paper appeared in an issue of *Chemical and Metallurgical Engineering* published shortly after November 11, 1919, (Ex. K, Vol. II, p. 919) and the complete paper was first published in April, 1920, in the *Journal of Industrial and Engineering Chemistry* (Ex. E, Vol. II, pp. 825-844).

Dr. Kratz had been identified with the chemistry of rubber and the use of accelerators in rubber manufacture for over seven years prior to the reading of the paper, with the Diamond, Goodrich and Norwalk companies, and, after April, 1917, with the Falls Rubber Company. The general subject of vulcanization was one to which he had directed his efforts almost exclusively for years, and he was intimately familiar with commercial practice in the use of accelerators.

The paper was recognized at the time of the Philadelphia meeting as of great value and importance; the audience consisted of the leading rubber chemists of the country, representing practically all of the rubber manufacturing companies, and many of them took notes of data presented by Dr. Kratz (Vol. I, p. 216, Q. 91-4; p. 532, Q. 6-7; p. 651, Q. 11-19; and Vol. II, p. 1018, Q. 3; p. 1023, Q. 4-5). In particular,

Tables I and II of the paper were written out upon a blackboard by Dr. Kratz, and the information covered by the tables was copied by many of those in the audience (Vol. I, p. 652, Q. 18-19; p. 213, Q. 73-4; and Vol. II, p. 1023-4, Q. 6-9).

The title of the paper is

"THE ACTION OF CERTAIN ORGANIC ACCELERATORS IN THE VULCANIZATION OF RUBBER."

After some preliminary discussion of the use of accelerators and the information on the subject available in the literature, the authors discussed their "own experience", leading up to the following (Vol. II, p. 830):

> "For example, in our preliminary experiments we found that urea was slightly more active than thiourea. Thiourea, in turn, was more active than monophenylthiourea, and the latter more active than diphenylthiourea. **The same was true in the case of the guanidines, both monophenylguanidine and diphenylguanidine being found more active than triphenylguanidine,** although the conditions of our experiment did not permit of a differentiation between the two substances first mentioned * * * In the case of the guanidines, **the great difference in activities of mono- and diphenylguanidines, when compared with that of triphenylguanidine,** may be attributed to the fact that in the latter substance the phenyl group has replaced imido rather than amido hydrogen." (Emphasis ours.)

Then, under the heading "Experimental Part", the procedure followed in carrying out the investigation is set forth in detail, including the kind of rubber used, the proportions of rubber and sulphur in the mixture, the manner in which the accelerator was incorporated and the method of vulcanizing. The data given is entirely sufficient to enable any rubber chemist to repeat just what was done; it is more specific and in greater detail than that given in the Weiss patent.

The description of the procedure employed and the results obtained reads, in part, as follows (Vol. II, p. 836-8):

> "The rubber used was good quality, first latex, pale crepe, and the same lot was employed in all mixtures.

All mixtures were made under standard conditions; the average time of each batch on the mill was 17.5 min. The same proportion of rubber and sulphur—92.5 parts rubber, and 7.5 parts sulphur—was employed in each instance, but the amount of accelerator was varied, according to the conditions of the experiment.

All of the accelerators soluble in alcohol were dissolved in the smallest quantity of this liquid and introduced into the rubber in solution. Those not soluble—and this applied to the anhydro-formaldehyde bodies only—were ground to 100 mesh and added to the rubber with the sulphur. After mixing, the mixtures were allowed a recovery period of 24 hours before they were vulcanized. Vulcanization was carried on in a platen press of the usual type.

* * * * * *

TABLE 1—RELATIVE ACTIVITIES—
THIOUREA SERIES

Parts Required to Equal One Part Aniline

Aniline	1.000
Urea	0.250
Thiourea	0.300
Monophenylthiourea	0.450
Diphenylthiourea	0.850
Monophenylguanidine (*a*)	0.075
Diphenylguanidine (Sym)	**0.075**
Triphenylguanidine	0.500

The activities of the various substances were compared in the mixture previously mentioned—92.5 parts of rubber and 7.5 parts of sulphur—taking as a standard the effect obtained with one part of aniline, vulcanized for 90 min. at 148° C. The amounts of various substances in the urea series required to effect the same degree of vulcanization as obtained with one part of aniline are shown in Table I." (Emphasis ours.)

In view of these quoted statements, the Kratz paper must be held to be a disclosure of the value of diphenylguanidine as an accelerator, a disclosure extending far beyond that contained in the Weiss patent. The paper states:

"both monophenylguanidine and diphenylguanidine being found more active than triphenylguanidine"

and refers to

> "the great difference in activities of mono- and diphenylguanidines when compared with that of triphenylguanidine."

Not only does the paper state that DPG is an accelerator of greater activity than TPG, but it gives figures representing the degree of the greater activity of the one over the other. Thus, the table of "Parts Required to Equal One Part Aniline" includes

Diphenylguanidine	0.075
Triphenylguanidine	0.500

which is a definite statement that 0.075 parts of diphenylguanidine would have as great an accelerating value as 0.500 parts of triphenylguanidine, or in other words, that DPG has about seven times the activity of TPG. This comparison of DPG with TPG is identically the same comparison that is used in the Weiss patent in disclosing the invention which the patent purports to cover; see particularly the sentence in lines 52 to 55 on page 1 (Vol. II, p. 718).

One of the expert witnesses testified that Tables I and II of the paper express the relative activity of the accelerators named by a method of comparison which is quite usual, in fact one of the two most commonly employed for the purpose (Vol. I, p. 532, Q. 8). These are the tables which were copied on the blackboard by Dr. Kratz. Table I is the table above quoted which includes DPG and TPG.

Plaintiff's expert, Dr. Whitby, paid a fitting tribute to the paper. He said he first learned that DPG was an accelerator from an abstract of the paper, and that the paper was the earliest he knew of relating to the use of DPG as an accelerator. Also, he is the author of a book on rubber in which, under a heading "Natural and Artificial Accelerators", he mentions "guanidine derivatives" and refers to this paper of Kratz, Flower and Coolidge as a source of information on the subject (Vol. I, p. 53-4, Q. 21-27; p. 67-8, Q. 85-6).

Defendant's witness, Shepard, Director of Organic Re-

search for the Firestone Tire & Rubber Company, testifying about the Kratz paper, said (Vol. II, p. 1024, Q. 14):

> "This paper was the first paper which gave us any definite idea of the relative activity of accelerators and as such was an extremely important paper, because having these relative activities we were enabled to apply the various accelerators sensibly."

Plaintiff's witness Daniels attended the Philadelphia meeting and heard Dr. Kratz read this paper; he said he had never heard a paper on accelerators so interesting as this one, nor a paper that gave as definite information (Vol. I, p. 216, Q. 92-95). Also, he said the paper stated the greater activity of DPG as compared with TPG and that the greater activity of DPG was shown by the matter which Dr. Kratz printed upon the blackboard in front of the audience (Vol. I, p. 215, Q. 83-4).

Furthermore, the sufficiency of the Kratz paper as a disclosure of the accelerating value of DPG finds most unusual confirmation in the conduct of Weiss himself. Weiss was employed up to March 15, 1920, by the Republic Rubber Company at Youngstown, Ohio, and on that date was dismissed from its employ. At that time, Weiss was married, had an infant child, and had little or no funds; the need for finding employment was compelling (Vol. I, p. 129, Q. 158; p. 157, Q. 324-5). With the necessities of that situation guiding his action, Weiss applied for employment with practically all the rubber companies in the Akron district (Vol. I, p. 128, Q. 153), and in doing so, of course it was only the most natural thing for him to dilate upon every achievement in the chemistry of rubber to which he could make any claim. What he did do was to refer repeatedly to Dr. Kratz's paper as showing the value of DPG as an accelerator and to claim as his own contribution only a process of making DPG in quantity.

Immediately after his dismissal from the Republic Company, Weiss applied to the Firestone Company for employment and was required to make out an application on a printed form provided by the Company (Vol. I, p. 157, Q.

321). The original of this application as written out by Weiss is Exhibit C herein (Vol. II, p. 823-4). In this application, Weiss himself wrote:

> "I have lately developed a process for the commercial production of symmetrical diphenylguanidine. The value of this product as an accelerator has been discussed by Dr. Kratz at the Phila. meeting of the Am. Chem. Soc. and taking aniline as a basis he has shown that .08% of this product is equivalent to 1% of aniline."

Weiss wrote this before the publication of the paper in print in April, 1920; this information came to him from Daniels who heard Kratz present the paper orally (Vol. I, p. 155-7, Q. 315-8; p. 218, Q. 103).

Also, Weiss wrote in this application that his laboratory tests showed that one part of DPG was equivalent to four parts of thio and to one and one-half parts of hexa and he testified that the mere statement of these ratios of equivalency would suffice to disclose the greater activity of DPG (Vol. I, p. 158, Q. 329). This emphasizes the sufficiency of the Kratz paper which expresses relative activity in the same way.

At the time of applying to the Firestone Company for employment, Weiss interviewed Shepard, and the latter testified (Vol. II, p. 1029, Q. 69) that Weiss then stated to him:

> "Of course, you know that diphenylguanidine is a good accelerator from what you have heard at the Philadelphia meeting."

What Shepard heard at the Philadelphia meeting was the paper read by Dr. Kratz; Shepard was one of the many persons present who took notes of what Dr. Kratz said and the tables he displayed on the blackboard (Vol. II, p. 1023-4, Q. 4-9).

In the course of this interview with Shepard, Weiss told in detail of the process of making DPG which he claimed to have invented, but, though there was such excellent reason why he should tell of all his accomplishments in the chemistry of rubber, Weiss never intimated that it was he who had dis-

covered the activity of DPG as an accelerator. Shepard said:

> "He made no mention of having discovered this material as an accelerator. In fact he ascribed the discovery to Mr. Kratz" (Vol. II, p. 1025, Q. 28; Vol. I, p. 159-161, Q. 336-346).

Later, Weiss applied to the National Aniline and Chemical Company for employment, and again he referred to the paper read by Dr. Kratz as showing the value of DPG as an accelerator. The formal application to the National Company is Exhibit B herein (Vol. II, p. 821-2). At that time also Weiss made no claim that he originated the idea of using DPG as an accelerator (Vol. I, p. 162, Q. 352; Vol. II, p. 1015, Q. 19).

Still later, Weiss approached Doty and Woodward, and once more referred to the activity of diphenylguanidine as one and one-half times as active as hexa and four times as active as thio, expecting them to understand from this that it was a superior accelerator (Vol. I, p. 164, Q. 362-4). In other words, he used the same method of comparison as that employed by Dr. Kratz in his paper to show the higher accelerating value of DPG.

Finally, when the application for the patent in suit was pending before the Patent Office, it was rejected in view of the disclosure in Dr. Kratz's paper which by that time had been published in a periodical, and the Patent Office Examiner said, in connection with this rejection (Ex. H, Vol. II, p. 895):

> "Applicant's disclosures of the use of said accelerator are not more specific than disclosed in the publication, hence the rejection."

In accordance with Patent Office procedure, the Examiner was required to address a letter on the subject to the Commissioner of Patents, and in the letter he said (Ex. H, Vol. II, p. 897), referring to the Kratz paper:

> "The publication is a clear disclosure of the use of di- and triphenylguanidine as an accelerator broadly,

> and as applicant's specification is no more than a broad disclosure of the use of the same reagent without disclosing any details other than that usually employed with accelerators of this class, it is considered that the publication constitutes a reference for the claims."

In reply to this rejection, there was no criticism whatever of the sufficiency of the paper as a disclosure of all that was contained in the Weiss application. Instead, affidavits were submitted attempting to establish an earlier date for Weiss. This constitutes an admission that the disclosure in the Kratz paper covered all that was claimed by the applicant and that the rejection was a proper one. Thus, in a similar situation, the Commissioner of Patents said:

> "The filing of the affidavit under the provisions of Rule 74 (now Rule 75) indicates that he concedes the pertinency of the references, and is now seeking a patent on the ground that his own invention was prior in point of time." (*Ex parte Saunders, 1883 C. D. 23, 24.*)

The Court of Appeals for the Second Circuit in the *National* case, summarized the situation as follows (292 Fed. 558):

> "The quotation above made from the file-wrapper contents is part of what the Examiner said, when he confronted Weiss' solicitors with the publication of Kratz's essay. Their reply was, not to call attention to the date of publication and rely on R. S. 4886; there was obvious recognition of the truth of the Examiner's criticism, and Weiss fell to affidavit making (under Office Rule 75), and carrying back his date of invention, so as to antedate Kratz's reading of his essay. The reason, and the only reason, for this is that Kratz by that essay proclaimed himself and his associates as having observed that D. P. G. was a better accelerator than T. P. G., *inter alia,* and this, as we have pointed out, and as the Examiner in substance said, was and is the sum total of this invention."

Plaintiff has asserted that the Kratz paper is insufficient as a disclosure of Weiss's invention because, while it states specifically that DPG is a far more active accelerator than TPG, it does not state that a superior rubber product is produced by the use of DPG. It was unnecessary to state that.

All of the rubber chemists who heard the paper knew it. One of the primary functions of an accelerator is and always has been to improve the quality of the rubber product and it is a general rule that the greater the activity of the accelerator the better the quality of the rubber. Carlton, a witness for plaintiff, said this was taught in the colleges ten years ago, and defendant's witness Sanderson explained why it was so, and numerous writers have commented on the improvement of rubber products by reason of the use of better accelerators (*ante*, p. 11-12). Furthermore, plaintiff claims that Weiss made the invention prior to the Kratz paper, and plaintiff's witness Daniels said he told Weiss, on his return from the Philadelphia meeting, that Kratz's paper showed the same result Weiss had gotten (Vol. I, p. 218, Q. 105), though it made no direct statement about the quality of the rubber, assuming that all present knew the basic general principle that better accelerators produced better rubber.

Labored attempts were made in the rebuttal proofs by the witnesses Williams and Whitby to criticize the Kratz paper but the comments of those two witnesses are too erratic and inconsequential to make specific reply worth while. If there were, (contrary to our belief,) some sound basis for criticism of Dr. Kratz' *conclusions* on debatable chemical theories and the reasoning by which he arrived at those conclusions, there would still remain untouched the direct and positive statement of fact made by Dr. Kratz to the assembled rubber chemists that DPG is an accelerator of greater activity than TPG, which is just what Weiss said and the only thing of any consequence in his patent. No amount of criticism can take from the Kratz paper the statement that DPG is "more active than TPG". That is what Dr. Kratz told the rubber chemists and that is one of the items they noted and took back home with them, just as Daniels noted it and took it back home to Weiss (Vol. I, p. 217-8, Q. 102-9). As to the formula Kratz used, it is set out in full in his Norwalk report and in his paper; Kratz said it was an old formula he had used for years before and after

his Norwalk work (Vol. I, p. 350, Q. 54), and he said time and again that he made slabs of rubber with this formula, using DPG as the accelerator. (Vol. I, p. 346, Q. 39; p. 350, Q. 53; p. 351-2, Q. 63; p. 353, Q. 68). It was unnecessary for defendant to go further with proof of the practical value of rubber made by this formula with DPG as the accelerator, because Weiss wrote in his Firestone application back in 1920 that his "laboratory tests" substantiated just what Kratz said (Vol. II, p. 824).

Plaintiff's witness Williams verified the accuracy of all those statements in the Kratz paper which are of importance in this litigation; he said that "if a tire manufacturer used diphenylguanidine as his accelerator, he would be able to produce a very superior article by using a low per cent. of diphenylguanidine and curing for a fairly long period at a low temperature" (Vol. I, p. 665) and that is precisely the operation described in the Kratz paper. Williams said the accelerating strength of monophenylguanidine and diphenylguanidine are "nearly the same" (Vol. I, p. 658, Q. 33) and that is precisely the relation stated in the Kratz paper. Williams referred to diphenylguanidine as having eight times the accelerating strength of tri-phenylguanidine (Vol. I, p. 666, Q. 53) and this again is precisely the relation stated in the Kratz paper.

Also, Williams indulged in some extravagant assertions based on *ex parte* tests as to which but few of the conditions are stated, which recall that when one "undertakes to prove that his adversary's process or machine is a failure, he always scores a success" (83 Fed. 696). If one wanted to score a failure, there is no art where that could be done with greater facility than in vulcanization.

As to all respects of importance in which Dr. Whitby criticised the Kratz paper, (Vol. I, p. 674, Q. 194-5) he put himself in direct conflict with Williams. Dr. Whitby, like Williams, gained his first knowledge of DPG from the Kratz paper, and in his book on rubber he refers to the Kratz paper as one of the authorities on the subject of accelerators (Vol. I, p. 53-4, Q. 21-6).

The proper estimate of the Kratz paper is given by plaintiff's witness Daniels and defendant's witness Shepard.

Daniels said he never before heard so interesting a paper on accelerators nor had he ever heard a paper which gave such definite information (Vol. I, p. 216, Qs. 93-4) and that in the course of the paper it was stated that DPG was more active than TPG and that this fact was shown by the matter posted on the board which Daniels copied and took back to Weiss (Vol. I, p. 214-5, Q. 78-84).

Dr. Kratz not only stated that DPG was a good accelerator and a more active one than TPG but also he stated definitely in figures how much better it was. His table included, in addition to DPG and TPG, two accelerators with which all rubber chemists were familiar, namely, aniline and thio (diphenylthiourea) and the figures told how much of DPG one would have to use to get the same accelerating effect as with given amounts of aniline and thio. This is perhaps the most serviceable method of indicating accelerating value; in any event it is one which cannot be criticised by plaintiff for Weiss used the same method in his application for employment at Firestone when he said his tests showed that one part of DPG "is equivalent to 4 parts of thiocarbanilide and 1½ parts of hexamethylenetetramine" (Ex. C, Vol. II, pp. 823-4). Again Weiss used this same method when he sought to convince Doty and Woodward of the Dovan Company that they should undertake to exploit DPG (Vol. I, p. 164, Q. 362-4).

So it is clear beyond all question that the Kratz paper is a full disclosure of the one idea disclosed in the Weiss patent. Tributes to its sufficiency came from all sides, including from Weiss himself. Also, the District Court in this case said in its opinion that in his paper Dr. Kratz

> "fully disclosed the subject-matter of the Weiss patent, more fully, indeed, than does the patent" (Vol. I, pp. 691-2).

Also, that is the conclusion reached by the Court of Appeals of the Second Circuit in the *National* suit, wherein that Court said (292 Fed. 558):

> "We hold that essay to be a complete disclosure of everything in the application for the patent in suit, and of a great deal more useful and accurately stated information."

This leads to a consideration of how the patent in suit came to be granted notwithstanding the reading and publication of the Kratz paper long before the application for the patent was filed.

File Wrapper of the Patent in Suit.

The application for the patent in suit was filed on November 12, 1921, *more than two years* after the Kratz paper was read on September 2-6, 1919, and *more than two years* after knowledge of the contents of that paper had been conveyed to Weiss by Daniels, and *nearly two years* after the Kratz paper had been abstracted in the technical press, and *more than a year and a half* after the paper had been published in full and widely distributed.

On December 29, 1921, the application was rejected (Ex. H, Vol. II, p. 861) in view of a brief and general reference to the use of DPG as an accelerator in an article published in the *India Rubber World*. That article was published on May 1, 1921, but it states that the article was read at a meeting of the American Chemical Society in Chicago on September 6-10, 1920. In reply to this rejection, brief affidavits of Weiss and one of his associates were filed for the purpose of establishing for Weiss a date of invention prior to September 6, 1920.

Then under date of January 13, 1922, the Examiner again rejected the application on the ground that the affidavits submitted were not sufficient. The Examiner's comment was (Ex. H, Vol. II, p. 868):

> "Merely stating that the invention was disclosed to others before Sept. 6, 1920, and reduced to practice—does not bring out *all* the facts in applicant's possession. To *whom* was it *disclosed* and when? When was it placed on the market and *where?* There must be a *completion* of the invention in this country before the date of the reference. Furthermore, a public address before the American Chemical Society disclosing completely the invention on Sept. 6, 1920, shows *knowledge* which applicant must overcome by bringing his dates back of Sept. 6, 1920."

Again Weiss replied with affidavits of himself and his business associates (Ex. H, Vol. II, p. 871-891). This time the Examiner concluded that the affidavits were sufficient to establish for Weiss a date prior to September 6, 1920, and accordingly the application was allowed on Feb. 15, 1922 (Vol. II, p. 892). Immediately thereafter, on February 20, 1922, the Kratz paper came to the Examiner's attention. This led him to write a letter to the Commissioner of Patents (Vol. II, p. 896-7) and also a letter of rejection (Vol. II, p. 895), and in those letters the Examiner made the statements, heretofore quoted (*ante*, p. 24-5) to the effect that the Kratz paper contained quite as full a disclosure of the use of DPG as an accelerator as the Weiss application, which, the Examiner said, was "no more than a broad disclosure" of the use of DPG "without disclosing any details other than that usually employed with accelerators of this class".

Again, Weiss resorted to affidavits, this time to establish a date of invention prior to September, 1919, when the Kratz paper was read (Vol. II, p. 902-910). Five affidavits were filed, based solely on the recollection of the affiants as to events which were then over three years old. They were accepted by the Examiner and no further objection to the application was made.

This procedure of filing affidavits to antedate a prior publication is covered by a rule and established procedure of the Patent Office, as is shown by the following extract from an opinion in a case decided by the Patent Office:

> "The rule requires that an applicant, having been rejected upon reference to some prior patent or printed publication, shall make oath to *facts* showing a completion of the invention by him before a certain date, as distinguished from a mere statement of his opinion that he has made such an invention. *Ex parte* Gasser, 17 O. G., 507. The affidavit should detail, therefore, the facts and circumstances upon which the applicant bases his claim of invention. * * *
>
> The prior patent or the printed publication affords to the public an adequate knowledge of the invention, and dedicates it to the public use. If the invention is to be reclaimed for the private use of the applicant, he should

show that he had before that time completed the invention and disclosed information of the same to others as full, accurate and exact as that afforded by the patent or publication, and also, that he has since preserved his right to a patent by a diligent prosecution of the same. No patent will hereafter be granted, therefore, for inventions disclosed in prior patents or publications until the applicant shows by exhibits or descriptions properly verified by oath that the invention was made and completed by him in a patentable sense before the date of the application upon which the patent was granted or before the date at which the printed publication was made." *Ex parte Saunders, 1883 C. D., 23.*

The showing made for Weiss in the affidavits filed was so meagre and insufficient that the Examiner should not have allowed the application, particularly so because the affidavits were unsupported by any document contemporaneous in date with the events covered by the affidavits. Weiss said in his final affidavit that DPG "was produced and actually used in the vulcanization of rubber goods during the early part of the year 1919" and Daniels said:

> "These tests were also carried out in the compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods."

The Examiner should have refused to accept these affidavits as sufficient in the absence of documents dated in 1919 and showing beyond question that the rubber goods were made and that the accelerator was used in them and proved to be efficient.

But we are not concerned with whether or not the Patent Office rule was properly enforced. What is of importance is that the patent was granted on a misrepresentation of the facts. Both Weiss and Daniels testified at the trial and their testimony makes it clear that the statements in their affidavits were without justification.

The only "rubber goods" which Weiss claims to have made "during the early part of the year 1919" were small test-slabs,

like Exhibit TT, and the only dated records of such test-slabs are three entries in the record book (Ex. 10, Vol. II, p. 725-769) of the laboratory of the Republic Rubber Company where Weiss was employed. Of these three, one has had its date changed and the other two relate to tests on shoddy (re-claimed rubber) compounds which do not indicate any superiority of DPG over TPG.

As to the Daniels affidavit, (Vol. II, p. 909-10), it states that such rubber goods as hose, tires, etc., were actually made at the Republic Plant in the early part of 1919 by the use of DPG, and nothing of that sort occurred in that year or at any other time while Weiss was with the Republic Company (Vol. I, p. 146-7, Q. 257-262). Plaintiff's only answer to this is that the Patent Office Examiner could not have understood this statement to mean what it says because, if the articles named had been made by the use of DPG in the early part of 1919, that in itself would have constituted a public use of the invention which would invalidate the patent. That does not follow at all. Even if all the articles named by Daniels had been made by the Republic Company in the early part of 1919 by the use of DPG in the course of developing and perfecting the use of DPG in such manufacture, that would not necessarily have any effect upon the validity of the patent. The validity of the patent could be affected by work of Weiss himself and the Republic Company where he was employed only if the work developed into commercial manufacture and *actual sale* more than two years before the application for the patent was filed. Nothing short of *public use* or *public sale* more than two years before applying for the patent constitutes a statutory bar. So there is no reason why the Patent Office Examiner should not have understood the affidavit to mean precisely what it says, and what it says is false. No such articles were made at the Republic Company with DPG in 1919 or at any other time while Weiss and Daniels were there.

It is evident, therefore, that the grant of the Weiss patent was secured by misrepresentation of the facts in *ex parte* affidavits. The Court of Appeals in the *National* case held this

to be the fact, saying that Weiss' testimony "is not wholly reconcilable with some of the affidavits used in the (Patent) Office" and the District Court in this case said that the affidavits submitted to the Patent Office were such as to "create a false impression" (Vol. I, p. 695). Now, however, the facts are brought out fully in the testimony and exhibits in this suit.

On the basis of these facts, we submit that the situation presented sustains three propositions, and that adoption of any one of the three requires rejection of this plaintiff's claim, namely:

1. The District Court held that "Weiss' testimony in the instant case shows various contradictions of statements made in prior steps in the case, some in regard to material matters" and that "the circumstances, as well as our observation of the witnesses, preclude us from giving great weight in the attempt to fix Weiss' discovery of DPG as prior to Kratz's disclosure" (Vol. I, p. 696); and it is an established rule of this Court and all other appellate courts that when the trial court has made a definite ruling as to the credibility of the witnesses produced before the court, that ruling will be adopted by the appellate court in the absence of manifest error.

This established rule of appellate courts should be considered in conjunction with the equally definite rule that a plaintiff attempting to establish an early date of invention for the patentee of the patent in suit in order to antedate an anticipation, can do so only by producing evidence proving the early date beyond all reasonable doubt. In the absence of palpable error on the part of the trial judge, the testimony offered by the plaintiff cannot properly be held to establish the claimed date *beyond all reasonable doubt* when it is a fact that the trial judge found plaintiff's testimony to contain various contradictions in material matters and not to be entitled to great weight.

2. If this Court shall consider plaintiff's testimony anew, the discrepancies, contradictions and misrepresentations ap-

pearing in it will be found to be so numerous and so substantial as to fully sustain the conclusion reached by the trial Judge.

3. If all parts of plaintiff's testimony which are supported by a contemporaneous record be accepted at their face value and subject to no depreciation on account of discrepancies, still it is necessary to conclude that all Weiss did prior to the reading of the Kratz paper was inconclusive, and "merely experimental and guided by no principle" and that it taught him nothing of any value about the use of DPG as an accelerator or its superior activity over TPG or any other accelerator.

These three propositions will now be discussed individually:

1. Adopting the trial Court's ruling.

In its opinion in this case, the trial Court discussed at length the evidence presented by plaintiff to establish the early date of invention claimed for Weiss. This discusison appears on pages 691 to 696 of Vol. I of the record. The date of the most important record presented by Weiss has been changed, as all agree, and the Court held that the change was from a date subsequent to the Kratz paper to a date prior thereto. As to another part of Weiss's testimony, the Court held "it is impossible to accept his testimony in this respect". Also, an affidavit made by Weiss' principal corroborating witness was quoted and then the Court said "The manifest effect of the immediately foregoing was, at best, to create a false impression". Then the Court pointed out that this witness stated in his testimony that certain tests were made subsequent to the Kratz paper, whereas he had previously executed an affidavit that the same tests were made before the Kratz paper. Then the Court commented on the various contradictions in material matters in Weiss's testimony. Finally, the Court held that the circumstances and the Court's "observation of the witnesses" made it impossible to sustain the plaintiff's claim to the early date of invention.

This situation calls for application of the rule, established in the following cases, that in the absence of manifest error

an appellate court will not go behind a ruling of the trial court on such an issue as credibility of witnesses; that ruling is to be "treated as unassailable".

Adamson vs. *Gilliland,* 242 U. S. 350.
Davis vs. *Schwartz,* 155 U. S. 631.
Kimberly vs. *Arms,* 129 U. S. 512-525.
Mason vs. *U. S.,* 260 U. S. 545.
Tilghman vs. *Proctor,* 125 U. S. 136-149.
Cramer vs. *U. S.,* 261 U. S. 219.
Lawson vs. *U. S. Mining Co.,* 207 U. S. 1.

The particularly pertinent statement of this Court in *Davis* vs. *Schwartz* (p. 636), quoted and applied in *Adamson* vs. *Gilliland,* is:

> "so far as it (the lower Court's ruling) depends upon conflicting testimony, or upon the credibility of witnesses, or so far as there is any testimony consistent with the finding, it must be treated as unassailable" (Cases cited).

It is no argument against the application of this rule that the Court of Appeals reversed the ruling of the District Court. Several reasons support that view. In *Adamson* vs. *Gilliland,* the Court of Appeals for the Eighth Circuit had reversed a decree of a Missouri District Court, and nevertheless this Court applied the rule above set forth, which, of course, is founded upon the superior position of the trial Judge in that he heard the witnesses and saw how they conducted themselves. Furthermore, the Court of Appeals committed an error in this case in not applying the rule above stated.* Finally, the Court of Appeals gave no statement of its reasons for not agreeing with and adopting the conclusion of the trial Judge as to the credibility of these witnesses.

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* See *Kimberly* vs. *Arms,* 129 U. S. 512, where this Court said at page 525:

> "We are, therefore, constrained to hold that the learned court below failed to give to the findings of the Master the weight to which they were entitled, and that they should have been treated as so far correct and binding as not to be disturbed, unless clearly in conflict with the weight of the evidence upon which they were made."

We maintain, therefore, that under the doctrine of *Adamson* vs. *Gilliland*, the ruling of the District Court on the credibility of plaintiff's witnesses on this all-important issue of plaintiff's date of invention, should be considered as unassailable, for certainly it is not manifestly wrong; and if that be done, the whole of plaintiff's case falls.

This proposition assumes even greater strength when considered in conjunction with the heavy burden of proof which a plaintiff must in any event carry when it undertakes to prove an early date of invention to antedate what would otherwise be an anticipation. For generations back the Courts which pass upon patent litigations have been applying the rule that when a plaintiff seeks to avoid the effect of an anticipation by proving that the patentee of the patent in suit made his invention before the effective date of the anticipation, he must establish his claim to the early date by evidence which eliminates all reasonable doubt. The principle involved is identical with that applying to proof of a prior use, which, under *The Barbed Wire Patent*, 143 U. S. 275, *Deering* vs. *Harvester Works* (*post*, p. 54) and similar decisions, is required to eliminate all reasonable doubt. In *Clark Thread Co.* vs. *Willimantic Linen Co.*, 140 U. S. 481, 489, this Court rejected the plaintiff's claim to a certain date of invention, saying:

> "Such testimony, given for the purpose that this was, is necessarily subject to the gravest suspicion, however honest and well intentioned the witness may be".

And in *Loom Co.* vs. *Higgins*, 105 U. S. 580, where the plaintiff offered testimony to prove the date of invention of the patent in suit in order to establish priority, this Court pointed out at page 594 that such testimony must be "received with caution".

The rule based on these decisions of this Court has been stated and applied by the lower courts in innumerable instances, among which are the following:

> "One who seeks to carry the date of invention back of a date of an anticipating patent assumes the burden of proof, and must establish the earlier date by evidence

so cogent as to leave no reasonable doubt in the minds of the Court that the transaction occurred substantially as stated. *Moline Rock Plow Co.* vs. *Rock Island Plow Co.*, 212 Fed., 727, 129 C. C. A. 337. The rule as to the burden cast upon the appellee in endeavoring to fix such a date is very strict. It is so easy to fabricate or color evidence of prior invention, and so difficult to contradict it, that proof has been required which does not admit of reasonable doubt."

Barber vs. *Otis Sales Co.*, 271 Fed. 171, 180, C. C. A. 2nd Cir.

"This date (of defendant's prior invention) being fixed, the burden was transferred to the complainant to satisfy the court by proof as convincing as that required of the defendant that his invention preceded theirs. The rule in such cases is very strict. It is so easy to fabricate or color evidence of prior invention and so difficult to contradict it, that proof has been required which does not admit of reasonable doubt. Where interests so vital are at stake, where intervening years have made perfect accuracy well nigh impossible, where an event, not deemed important at the time, has been crowded from the memory and obscured by the ever varying incidents of an active life, it is not difficult to imagine that even an honest man may be led erroneously to persuade himself that the fact accords with his inclination concerning it.

"The evidence of prior invention is usually entirely within the control of the party asserting it, and so wide is the opportunity for deception, artifice, or mistake, that the authorities are almost unanimous in holding that it must be established by proof clear, positive and unequivocal; nothing must be left to speculation or conjecture."

Thayer v. *Hart*, 20 Fed. 693, C. C., S. D. N. Y.

See also:

Westinghouse, etc., Co. vs. *Catskill, etc., Co.*, 121 Fed. 831.

New England Motor Co. vs. *Sturtevant Co.*, 150 Fed. 131, 137, C. C. A., 2d Cir.

Wendell vs. *Amer. Laundry Co.*, 248 Fed. 698, C. C. A., 3d Cir.

Thacher vs. *Board of Supervisors,* 235 Fed. 724, 725.

Columbus Chain Co. vs. *Standard Chain Co.,* 148 Fed. 622, 629, C. C. A., 6th Cir.

As stated in the *Westinghouse* case quoted by Judge Lacombe in the *New England Motor Co.* case, a patentee who seeks to establish an earlier date of invention must "furnish the Court with convincing proof that the anticipation has been anticipated."

Thus it is a rule that has governed the decision of patent litigations for generations past that a plaintiff can be given the benefit of a date of invention prior to an anticipation only when the evidence proves the early date beyond all reasonable doubt. And manifestly, the greater the period of unexplained delay after alleged completion of the invention and before applying for patent, the stronger must the evidence of the early date of invention be. In this instance the delay after the claimed completion of the invention and before filing the application for the patent in suit is a matter of years. Plaintiff claims it has proven a date of invention for Weiss in March, 1918, or February, 1919, or some time between those dates, and Weiss's application for the patent in suit was not filed until November, 1921. So the period of delay is from two and two-thirds to three and one-half years.

This rule of evidence and the conclusion of the trial court should be considered together, and when so considered, we think they warrant dismissal of plaintiff's claim without detailed examination of the evidence submitted in proof of the alleged early date of invention. When the law requires proof beyond all reasonable doubt and the trial judge who had the great advantage of hearing and seeing the witnesses refused to accept their testimony because of contradictions on material points, the requirement as to the evidence necessary to establish the claim is not fulfilled, for some doubt which is entirely reasonable must still remain.

2. Credibility of Weiss and his corroborating witnesses.

If the evidence submitted by plaintiff in support of its claim to a date of invention prior to the Kratz paper be subjected to independent examination, it will be found that the trial Court was entirely correct in holding that it discloses various contradictions of statements on material points and is not worthy of acceptance.

Weiss claims that he conceived the idea of using DPG as an accelerator in March, 1918. At that time he was in the employ of the Republic Rubber Company at Youngstown, Ohio, as a chemist. He had been employed there since October, 1917, and prior to that he had had no experience in the chemistry of rubber. His immediate superior was C. A. Carlton, a witness for plaintiff. Carlton had been particularly interested in the use of guanidine derivatives as accelerators and had used TPG (Vol. I, p. 92-3, Q. 16) and he discussed the use of these substances as accelerators with Weiss.

In the course of one of these talks, Weiss produced a copy of Richter's Organic Chemistry, a standard chemical handbook, and opened it to the page for the phenylated guanidine derivatives. There he found triphenylguanidine and the usual dictionary data with reference to it, and immediately next to it was diphenylguanidine with the corresponding data about that, for it must be understood that DPG has been a known substance for generations past. Seeing this data about DPG and knowing that TPG was an accelerator, led Weiss to suggest that possibly DPG would be an accelerator too and that it would be well to try it, with which suggestion Carlton agreed (Vol. I, p. 93, Q. 16; p. 95, Q. 27-9).

This is all there is to the allegation of conception of this idea in the early months of 1918. It depends entirely upon recollection of what is said to have occurred seven years prior to the trial. Also, in connection with this, it is well to have in mind some facts about Carlton bearing on his credibility. In the *National* suit there was a motion for preliminary

injunction and Carlton made an affidavit in behalf of *defendant,* in which he said (Vol. II, p. 1003):

> "When Morris L. Weiss came into the employ of the Republic Rubber Company I was doing research work on the guanidines and had developed TPG. When preparing to leave the employ of the Republic Rubber Company I directed and advised the said Morris L. Weiss to proceed with research work on the phenylated guanidine derivatives, including monophenylguanidine and diphenylguanidine as well as the guanidine bases."

Very soon thereafter Carlton made an affidavit for *plaintiff* stating the facts very differently and in that second affidavit he said that since signing the first one he had talked with Weiss. Then the *National* suit came on for trial and Carlton appeared as a witness for plaintiff. Immediately thereafter he became an employee of the plaintiff (Vol. I, p. 628-632, Q. 109-130).

Next Weiss said that he made some effort to gather data about DPG at the library in Youngstown in May, 1918, and at the Public Library in New York in June, 1918. He said this work at the New York library was done when he was in New York on a vacation, that this vacation covered the first two weeks of June, 1918, and that he returned to Youngstown on June 16th, having missed the train that was to get him there on the 15th (Vol. I, p. 136-7, Q. 206-214, and National Rec. p. 263, Q. 323-5). But the record book of the laboratory of the Republic Rubber Co., where Weiss worked, always referred to as "the X-book" (Ex. 10) contains records of numerous tests recorded by Weiss during this very period when Weiss said he was in New York, such, for instance, as those on pages X-2031 and X-2005 (Vol. I, p. 137, Q. 214; and Vol. II, p. 747 and 731).

The next event, according to Weiss, is that in September, 1918, he started to prepare some DPG and produced five grams in two experiments, and in December he used the five grams "in a rubber compound to try out its activity to find out what it would do with the rubber" (Vol. I, p. 103-4, Q. 54-7). With this DPG, three test-slabs were made, all of

them were overcured and in making them the entire five grams of DPG were used up (Vol. I, p. 104-7, Q. 60-86).

All of this is in such direct conflict with the story as told by Weiss on another occasion that no word of it is entitled to belief. Weiss attempted to tell the story in an affidavit which he signed for use in the *National* suit and there he told it altogether differently. There he said the amount of DPG he prepared in September, 1918, was not sufficient for a test in a rubber compound. His exact words are:

> "As a result of this examination at the New York Public Library, I found very little literature on diphenylguanidine but found sufficient data to enable me to prepare a small quantity of diphenylguanidine which I did during the month of September, 1918. The quantity prepared at that time was not sufficient to permit a test in a rubber compound" (Vol. I, p. 142 and Ex. A, Vol. II, p. 812).

Weiss had to admit that this is inconsistent with his testimony in this case (Vol. I, p. 142-3, Q. 244-6).

Thus there is an unexplained and unexplainable variance on the all-important point of when Weiss first made DPG, what he did with it and when he first used DPG in a rubber compound. Two wholly irreconcilable versions of such important items are at best a sharp warning against acceptance of his testimony in the absence of entirely adequate corroboration.

So turn for a moment to his corroboration. A witness named Halliday (Vol. I, p. 231-242) attempted to tell from recollection about a test he made seven years earlier, which test was one of about 40,000 tests he made in the course of some ten years of employment with the Republic Company, although there was nothing whatever to mark the test in his mind, not even knowledge of what was in the compound tested. He undertook to pick out this one test from along in the middle of ten years of work which consisted of doing the same thing 40,000 times, and to say that, in this instance, the compound had a white powder in it, though he did not know what the white powder was (Vol. I, p. 236, Q. 16), and many of the other compounds from which he made test-slabs

had white powder in them, including all of the compounds in which TPG was the accelerator. He even undertook to state what Weiss said and what he said, and where Weiss stood with reference to his testing machine on the occasion of this one test in 40,000 in the course of ten years (Vol. I, p. 238). There is nothing which at the time would have marked this test as unusual in any way; it was a usual test formula, the inclusion of an accelerator was the usual thing, an accelerator in the form of a white powder was in no respect unusual, and there is no suggestion that the test differed in any way from all of the others that Halliday made at about this time for Weiss and for all of the other four or five men for whom Halliday produced test-slabs day after day and year after year in the ordinary routine operation of a testing machine.

Weiss tried to develop Halliday's story by saying he told Halliday the white powder was "diphenyl", but that means nothing for even if we credit Weiss with an extraordinary memory that enabled him to tell what he said to one of the various workmen who helped him many years ago, still the word "diphenyl" may only have indicated diphenylthiourea which is the chemical name for "thio", the accelerator used so largely in the Republic plant. The whole of the deposition of Halliday, depending as it does merely on recollection under circumstances which presented no occasion for any details of the test to stick in his recollection, is utterly valueless as corroboration of Weiss.

Corroboration was also attempted by the witnesses Nellen and Daniels. Nellen's deposition is as meaningless as Halliday's. Nellen said Weiss told him something about DPG but he would not attempt to fix the date any closer than to say it was between February 1st and November 1st, 1919 (Vol. I, p. 230, Q. 22-3). Of course during September and October of 1919, Weiss did know something about DPG because early in September Daniels told him what he had learned from Dr. Kratz, and we are in accord with plaintiff that there was marked activity in the Republic Company's laboratory in experimenting with DPG throughout the last half of September and the whole of October. So what Nellen said amounts to nothing at all.

The only other corroborating witness is Daniels. He departed from the truth to such extent that everything he said must be open to suspicion. He is the individual whose affidavit was filed in the Patent Office in soliciting the grant of the Weiss patent and in which affidavit the facts were misrepresented, as we have heretofore pointed out (*ante*, p. 31-2). In that affidavit he said that "during the early part of the year 1919" DPG used by the Republic Company "proved to be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods", whereas the fact is that the Republic Company never used any DPG in the manufacture of those rubber goods or any other rubber goods up to the time when Weiss and Daniels were dismissed from its employ in March, 1920 (Vol. I, p. 146-7, Q. 257-9). It was probably in reliance on the statements in this affidavit that the Weiss patent was granted, for the Patent Office, quite naturally, gives primary weight to the affidavit of someone other than the applicant. So this misrepresentation of facts by Daniels may be responsible for all this litigation.

Daniels again misrepresented the facts in an affidavit which he signed for use in the *National* suit. In that affidavit, he said (Ex. UU, Vol. II, p. 999 and p. 724):

> "I attach hereto photographic copies of one page of the laboratory X-book kept by me, said page being numbered 1777, which contains an entry made by me early in the year 1919, in which entry I recorded a compound to be used as a splicing cement for red inner tubes for automobile tires."

This entry is undated and Daniels' statement that it was made "early in the year 1919" was false. He must have known then that it was made at a later time, just as he knew it was made later when he testified in this suit; and its position in his X-book immediately following other records dated in the fall of 1919 plainly indicated that it was not made in "the early part of 1919". Testifying in this suit, Daniels said he wrote his entry in his X-book "late in the year 1919 or early in the year 1920" (Vol. I, p. 207, Q. 37). He got

around to saying this reluctantly, first saying that he was not absolutely certain whether this entry was made "in the summer or in the fall of 1919" (Vol. I, p. 207, Q. 28).

This perversion of the truth by Daniels is one of several efforts made by the witnesses for plaintiff to make experimental work which was done in the fall of 1919 appear to be work done in the summer of 1919, the difference being all-important because it makes all the difference between what have been called a *post*-Kratz and a *pre*-Kratz experiment.

Plaintiff's counsel have characterized this false statement in the Daniels' affidavit as "an inconsequential error". But on the contrary it was an error in a vital matter. The whole purpose of the affidavit was to prove that Weiss had completed his invention prior to the Kratz paper, and in achieving that purpose this experiment by Weiss was put forward as one of the things Weiss did with DPG prior to the Kratz paper. So when Daniels said it was done "early in the year 1919", he made the experiment of vital importance when in fact it was wholly irrelevant by reason of having occurred after the Kratz paper.

Furthermore, Daniels is directly contradicted on two important points by defendant's witness Clark, who was his immediate superior in the Republic Company. Daniels said he told Clark of Weiss' work on DPG in the spring or summer of 1919 (Vol. I, p. 222, Q. 135) and Clark said that was not so (Vol. I, p. 444, Q. 34-8). Also Clark and Daniels are directly opposed as to whether there was discussion of dismissing Weiss from the employ of the Republic Company early in 1919 (Vol. I, p. 221, Q. 125-131 and p. 443-4, Q. 28-35).

Going back to Weiss and his story, it appears that some few weeks after he made his first DPG he made a second lot which was about 25 grams. This is stated to be the fact both in the affidavit (Ex. *A*, Vol. II, p. 812) and in his testimony in this suit (Vol. I, p. 103-7, Q. 54-82). But another discrepancy arises as to the date when this second batch of DPG was made. In his testimony in this case he said the 25 grams of DPG were made *before* a trip in January 1919, to Pittsburgh

to consult the literature in the Carnegie Library (Vol. I, p. 140-1, Q. 230-9). In the affidavit, however, the opposite is stated to be the fact. In the affidavit he said he did not have sufficient data about DPG and that he went to the Carnegie Library in Pittsburgh to get additional data, and that there he "found descriptions of various processes for making DPG by laboratory methods" and that it was after his return to Youngstown with this data he had collected at Pittsburgh that he made the second batch of DPG which amounted to 25 grams (Ex. A, Vol. II, p. 812 and Vol. II, p. 141-3, Q. 240-6).

No record of any of this work is produced. The laboratory where Weiss worked had the special record book, known as the X-book, in which all work done was supposed to be recorded. Defendant's witnesses, Brill and Clark, and plaintiff's witness Daniels, all stated unqualifiedly that it was a rule of the laboratory that all experiments and tests conducted there were to be recorded with care as a permanent record for future reference (Vol. I, p. 305, Q. 35-8; p. 219, Q. 113-7; Vol. II, p. 1008-9). Weiss said there was some special dispensation in his favor, leaving it to his judgment as to what parts of his work he would record, but this was repudiated by his principal corroborating witness, Daniels (Vol. I, p. 152-3, Q. 291-7; p. 219-220, Q. 114-120).

So all of this work, if it was done, should have been recorded and the records of it should now be available and should be in evidence in this case. But no record was produced. Instead, Weiss said he recorded how he made his DPG in a personal note-book kept by him, not in any laboratory records where it should have been recorded, and of course this note-book was consumed in a fire which occurred at the plaintiff's first plant (Vol. I, p. 113, Q. 108; p. 201, Q. 548-551). Weiss' "personal records", including one which he produced when he thought it would serve his purpose, (Ex. 5) he said were at his home, but this personal note-book, though it was a "personal record", was in the plant and according to Weiss was burned.

In reality, nothing with any continuity or momentum to it was done with DPG in the Republic plant prior to September 6, 1919. After that date there was feverish activity. The significance of this is so overwhelming that Weiss and his associates have yielded to the temptation to try to change some of the *post*-Kratz work into *pre*-Kratz work and the result is falsification. The statement in the Daniels affidavit above referred to is one instance and there are others on which we shall comment.

On the portion of Weiss' story to which we have referred, the corroboration by Daniels is of the most general character. He said Weiss told him "he had an idea about the production of DPG" and that Weiss made some test-slabs "that looked pretty good" and that he saw and felt these test-slabs (Vol. I, p. 204, Q. 15-16). In what respect they looked "pretty good", and how long they were cured, and how much accelerator was used in them, and whether they indicated in any way any advantage in the use of DPG over using TPG were not mentioned by Daniels.

Plaintiff's counsel have asserted that Weiss's statements are corroborated by affidavits of Seil and Greenwald filed in the Patent Office in connection with the Weiss application. By what rule of law these *ex parte* affidavits become evidence in this case is not suggested. Probably if Seil and Greenwald had been produced for cross-examination it would have developed that the allegations in their affidavits were untrue, just as actually did happen in the case of Daniels. The very fact that these men, Seil and Greenwald, were not produced as witnesses for the plaintiff on the vital point of what Weiss did with DPG prior to the Kratz paper, justifies the inference that, if produced, their testimony would have been unfavorable to plaintiff.

Summarizing the foregoing, we submit that on the basis of such unreliable evidence as that of Weiss, Halliday, Nellen and Daniels, one would not be warranted in accepting any of the assertions about Weiss's work with DPG prior to September, 1919, in the absence of corroboration in a contemporane-

ous document. This narrows the field of consideration to a small number of tests recorded in the X-book of the Republic Rubber Co., (Ex. 10) and consideration of them throws further light on Weiss' credibility. We shall refer to them in the order in which Weiss mentioned them in his testimony beginning on page 114 of the record. As to all these tests and the X-book in which they are recorded, Weiss is the only individual who gave any specific testimony about them. Daniels, his immediate superior who claimed that he kept in daily touch with Weiss's work, said he had no recollection of looking at any specific records Weiss made at the time of these tests (Vol. I, p. 204-5, Q. 16-18), and he did not identify either the X-book or any of Weiss's tests in it. Thus this X-book, the only contemporaneous document dealing with these tests, depends for its authentication on the testimony of Weiss alone.

First there is the entry in the X-book on page X-2034, column E (Ex. 10, Vol. II, p. 748 and 749). Its date has been changed and Weiss said he changed it (Vol. I, p. 153, Q. 299). It is fitting that this history of Weiss, with its fire that burned up his note-book where everything of value was recorded, affidavits misrepresenting the facts and affidavits at variance with the testimony, should have also a record whose date has been changed. If this date is important, the test recorded in connection with it should be dismissed from consideration. And it is important for it involves all the difference between a test made *before* and one made *after* Weiss was given Dr. Kratz' data about DPG. Certainly this test is entitled to no consideration as a *pre*-Kratz test; but at present we are discussing only Weiss's credibility.

Weiss said the date as originally written probably was "1-10-19"; he said

> "I might have put down '1/10/19' and corrected myself, making a '2' out of the '1'" (Vol. I, p. 191, Q. 491).

But examination of the original X-book we think should make one feel very sure that what Weiss said is untrue. The

Judge of the District Court looked at the date as it appears in the X-book with the aid of a strong magnifying glass and was thoroughly satisfied that the figure put there originally was a "9". He said:

> "A casual examination discloses that the month has been changed; and an examination under a strong glass plainly shows that the 2 was originally 9, thus making the original date September 10, 1919, 3 days after Kratz's table of accelerators had been given to Weiss" (Vol. I, p. 693).

Furthermore, a handwriting expert, Mr. Haring, was produced by defendant (Vol. I, p. 447-472) and he stated unqualifiedly that the original figure was a "9", (Vol. I, p. 447, Q. 5-6) indicating September 10, 1919, a date subsequent to the acquisition by Weiss of knowledge of Kratz's work. Mr. Haring said that the original figure could not have been a "1" and he gave what we think are convincing reasons for his conclusion that the figure initially written was a "9". Furthermore, he stated that he reached this conclusion before any suggestion was made to him as to what figure any individual thought was there originally or what conclusion by him would favor the contention of one side or the other in this suit (Vol. I, p. 451, Q. 20).

Furthermore, this test recorded on page X-2034 is a test on a pure gum stock as distinguished from a shoddy or reclaimed rubber stock and Weiss said this test with the pure gum stock was the first one he made (Vol. I, p. 114). To the contrary, however, is a statement by Weiss in the *National* case where he said that his "first thought" after he had made some DPG was to see how it would work with shoddy (Vol. I, p. 173, Q. 411, and Nat. Rec. p. 229). If this statement was true and Weiss did proceed first to see how the DPG would work in a shoddy compound, it would follow necessarily that the test recorded on page X-2034 was not made on February 10, 1919, but was made at a later time after Weiss's tests with shoddy compounds and in fact after the reading of the Kratz paper.

Next Weiss said he recorded a test in column G on page X-2006 (Vol II, p. 731) but on that entry there is no date, so there is nothing but Weiss's assertion, for such value as it may have, that the test was made early in 1919.

Next he referred to two tests on shoddy compounds, that is compounds in which the rubber ingredient is re-claimed rubber. These two tests are recorded in column H on page X-2006, (Vol. II, p. 731), dated February 21, 1919, and in column A on page X-2042 (Vol. II, p. 753), dated March 4, 1919. We shall comment at length upon them later (*post*, p. 58-9).

Next Weiss referred to tests recorded on page X-2010 (left) column H and X-2010 (right) column H (Vol. II, p. 736). The latter is the only one in which DPG was used and it is dated "9—29—19", so it is distinctly a *post*-Kratz test occurring during the period of great activity in testing DPG immediately following Daniels' return from hearing Dr. Kratz' paper at Philadelphia. Because of this date, Weiss tried to tie this test up with the one in Column H on the left dated September 6, 1919, where a different accelerator was used; this latter test is dated September 6, 1919, and it seems to have been Weiss's hope that these two tests would be considered as one, made all at the same time, for the purpose of comparing two different accelerators. This is one more of the numerous efforts to draw work done subsequent to September 6, 1919, back to a time prior to that date. This instance is a feeble effort because there is no reason why one should assume that the test recorded in column H on page X-2010 at the right was not made on the date noted. namely, September 29, 1919; the formula used may have been a standard formula, or, in making the test on September 29, Weiss may have wanted a comparison with the result he got in another test with a different accelerator recorded on September 6th. Or, what is more probable, Weiss may have wanted to compare DPG and TPG so he used those two accelerators in closely similar shoddy compounds, both on

September 29th, and recorded both tests in columns G and H on page X-2010 at the right.

Weiss said he got the recipe for these tests from Nellen to whom he talked about DPG "late in the summer of 1919" and "some time in August, 1919" (Vol. I, p. 118, Q. 118-9). Here is another effort of Weiss to pull something back into the period prior to Sept. 2-6, 1919. But he had no way whatever of fixing the date when he talked with Nellen beyond saying that it was a "few months" after some other event and that he, Weiss, had his coat off at the time (Vol. I, p. 118, Q. 120). Of course, if the "few months" had been one more month than Weiss thought of as a few months, the talk with Nellen would be in September, after the Kratz disclosure, and we frequently have warm enough weather in September for a man working around a factory to leave off his coat, even assuming that six years after the event Weiss could recall the month of an unimportant talk with a co-worker and the condition of the wholly unrelated matter of his apparel at the time of the talk.

Nellen testified as a witness for plaintiff but he would only say that he gave a standard shoddy formula to Weiss at some time between February 1st and November 1st, 1919, which, of course, means nothing (Vol. I, p. 230, Q. 18-26).

Next Weiss said he made "some hundred grams of DPG some time in August of 1919" (Vol. I, p. 122, Q. 132), though he gave nothing whatever as a reason for stating that this DPG was made in August and not in September, after Daniels told him on the strength of Kratz's paper that DPG was an active accelerator, nor is there any record of the manufacture of this DPG, or of any use to which it was put prior to September 10th. There is just the wholly unsupported statement of Weiss, an interested witness shown to have stated most important items of his story in irreconcilably conflicting ways and endeavoring to state from memory of occurrences six years old whether or not he did a thing in one month or in the month immediately preceding.

Counsel for plaintiff have referred time and again to

this supply of DPG, said to amount to several hundred grams, which Weiss is supposed to have made at some time in the summer of 1919 prior to the Kratz paper. They say it is improbable that DPG in an amount anything like 200 grams would have been made unless it had been intended to put it to some real use. The fault in their discussion is that there is no acceptable proof that any such supply of DPG was made by Weiss at any time prior to the Kratz paper. It is altogether probable that Weiss did make a supply of DPG immediately after the reading of the paper for he was instructed to do so by Daniels. But as to making it before the Kratz paper, there is just Weiss's statement that he made this supply "some time in August of 1919". Testifying five years after the event, it is impossible that one could say truthfully that the event occurred in August and not in September without some reliable document to assist his recollection. The only semblance of corroboration is Daniels' testimony; he said this DPG was made "in the summer of 1919" (Vol. I, p. 206, Q. 25), and in the next few answers, notably the answers to questions 28 and 37, he showed how impossible it was for him to state the date of any of these events with any accuracy.

Next Weiss told of the inner-tube splicing cement made with DPG and said that was made "in the summer of 1919" (Vol. I, p. 123, Q. 135). This is the cement made at Daniels' instigation, to which we have heretofore referred (*ante* pp. 43-4) and here Weiss and Daniels are in direct conflict. Weiss said the cement was made "in the summer of 1919", whereas Daniels said this splicing cement was made "late in the year 1919 or early in the year 1920", (Vol. I, p. 207, Q. 37) and obviously it was made as Daniels said, late in 1919 or early in 1920, for the undated record of it on page X-1777 (Ex. 9, Vol. II, p. 724) is preceded by pages dated in the late fall of 1919 and followed by pages dated in 1920.

Next Weiss referred to a test entered on page X-2064, column D (Vol. II, p. 764) and made in October, 1919, one

of the considerable number of tests of DPG made by Weiss after he had been informed by Kratz of the value of DPG.

Next he referred to the undated tests with DPG in the six columns on page X-2066 (Vol. II, p. 765). These tests he said were made in the summer of 1919 (Vol. I, p. 125, Q. 139). Nothing but the unaided recollection of this interested witness is given by way of fixing these tests in the summer rather than in September or October, 1919, and this page, X-2066, follows three pages of tests in September, October, November and December, 1919, and is followed by pages of tests in 1920. Also, the entry of these tests is in ink of the same distinctive color used on the pages immediately preceding. Mr. Haring, the handwriting expert, said that this ink was not used in making any of the entries in the X-book dated prior to the Kratz paper (Vol. I, p. 451-2, Q. 21-5). Furthermore, when Weiss was on the witness stand in the *National* suit and told about his two tests with shoddy compounds and the one test with the changed date, he was asked if the X-book contained any other record of a test with DPG made prior to September 2-6, 1919, and was instructed to go through the X-book in search of any such test, and at no time did he ever suggest that these entries on page X-2066 or any others in the X-book, except for the three above identified, were made prior to September 2-6, 1919 (Vol. I, p. 170-1, Q. 398-403, and Nat. Rec. p. 280-1, Q. 428-30).

The only other tests to which Weiss referred are those in the X-book dated in October and November of 1919, and not only do we admit that such tests were made and recorded in the X-book, but we call attention to them and to the considerable number of them, in fact the enormous number relatively to the number of recorded tests prior to the Kratz paper.

This consideration of Weiss' testimony about the tests he made with DPG and the record of them in the X-book, reflects further upon his credibility. The persistent effort to place events prior to September, 1919, with no reason for doing so and the contrary plainly indicated, the change of

the date in the record of one of the tests, the conflict between Weiss and Daniels as to the time of the splicing cement test, the placing of one series of tests in the *pre*-Kratz class when that was not done in the *National* suit though Weiss was asked what tests he put in that class, etc., added to the irreconcilable conflict between Weiss' testimony in this case and the affidavit he gave in the *National* case, and the absence of records of the tests he said he made in a place where he was duty-bound to record them, condemn him so strongly that, in our opinion, he is completely discredited. Also, the same conclusion should be reached with respect to Daniels; the grounds for this conclusion with respect to him are less numerous but are equally serious.

This conclusion, so far as Weiss is concerned, was reached by the Examiner of Interferences in the United States Patent Office in a decision in an interference proceeding. Weiss's record in that interference and the brief in his behalf are in evidence in this suit as Exhibits D and VV. The question at issue in that proceeding is which one of three applicants for patents, Weiss and two others, was the first to originate the use as an accelerator of another di-substituted guanidine called ditolylguanidine, to which reference was made from time to time in the record of this suit. Weiss claims to have conceived the idea of using ditolylguanidine (DTG) in 1919 and to have disclosed it to Daniels and later to his associates in the Dovan Company, Doty and Woodward. It was shown in the record of the intereference that Woodward tried by improper methods to influence the testimony of a witness called in behalf of one of the other parties. This is the matter referred to on pages 646-7 of the record in this suit and pages 274-6 of Exhibit VV. Also, it was shown that Weiss had tried improperly to influence the testimony of another witness. The decision of the Patent Office, a certified copy of which was filed in the District Court, includes the following:

> "A cloud of doubt is cast over all the evidence advanced by Weiss by the occurrence of two incidents

during the taking of testimony by the party Scott, either of which alone would seriously affect the credibility of the Weiss testimony. It appears that at the instigation of Woodward (who is interested in this proceeding and whose corroboration is relied upon by Weiss) an effort was made to influence the testimony of Dr. Weber, rubber expert, called in rebuttal by the party Scott. (Scott record, pages 287 and 289). The second incident likewise occurred during the taking of rebuttal testimony by Scott, and is even more serious than the first. There is more than a strong suspicion that the party Weiss himself endeavored to intimidate the witness Abrams into silence on the witness stand by threats of uncomfortable cross-examination if he should say too much. (Scott's record, p. 267 and 270).

"Little weight can be given any of the Weiss evidence where such grossly unethical conduct was indulged in."

For these numerous reasons we think the whole claim of this plaintiff that any work with DPG was done by Weiss prior to the Kratz paper of September, 1919, should be rejected on the ground that the testimony offered in support of it is altogether too unreliable. The comment of this Court in *Deering* vs. *Harvester Works* (155 U. S. 286, 300) is particularly applicable here:

"As we have had occasion before to observe, oral testimony, unsupported by patents or exhibits, tending to show prior use of a device regularly patented is, in the nature of the case, open to grave suspicion. *The Barbed Wire Patent*, 143 U. S. 275. Granting the witnesses to be of the highest character, and ever so conscientious in their desire to tell only the truth, the possibility of their being mistaken * * * are such as to render oral testimony peculiarly untrustworthy; particularly so if the testimony be taken after the lapse of years from the time the alleged anticipating device was used. If there be added to this a personal bias, or an incentive to color the testimony in the interest of the party calling the witness, to say nothing of downright perjury, its value is, of course, still more seriously impaired. This case is an apt illustration of the wisdom of the rule requiring such anticipations to be proven by

> evidence so cogent as to leave no reasonable doubt in the mind of the Court, that the transaction occurred substantially as stated."

Also, in connection with the frequent assertions of Weiss and Daniels that this or that was done "in the summer of 1919", expecting one to understand from this general statement that the test in question was made prior to the Kratz paper of September 2-6, 1919, rather than after it, a particularly pertinent precedent is found in *Clark Thread Co.* vs. *Willimantic Co.*, 140 U. S. 481-493. There an anticipating patent was presented by defendant having an effective date of July 22, 1858, and the patentee endeavored to offset its effect by testifying about what he did in July 1858, that is, making no statement as to whether it was done before or after July 22. Just so in this case, Weiss and Daniels spoke repeatedly of this or that as done in the summer of 1919, without specifying whether it was done before or after September 2-6, 1919; and anything Weiss did with DPG after September 6, 1919, is of no avail to plaintiff for by that time Weiss had been advised by Kratz of the value of DPG. In the *Clark Thread* case (p. 488), this Court said:

> "The generality of the expression,—'July 1858'—excites attention, and in this case it is not applying too strict a rule to say that the evidence should be construed most strongly against the complainants; and this would necessarily lead to the inference that the invention was completed in the last part of July, subsequent to the publication of the English patent. We feel bound to put this strict construction upon the patentee's evidence because such testimony, given for the purpose that this was, is necessarily subject to the gravest suspicion, however honest and well intentioned the witness may be."

3. Weiss's Work Prior to the Kratz Paper.

Suppose now we assume that all the records produced by plaintiff are accurate and that the various tests were made; even so, all the work Weiss did with DPG up to September, 1919, was inconclusive. It was wholly lacking in continuity,

in momentum, in progress toward any useful result. The truth of this statement (1) was stated plainly and directly by *plaintiff's* witness Daniels; (2) is clearly indicated by the course of the work on accelerators at the plant of the Republic Rubber Company; and (3) is shown by the records of the tests.

First, plaintiff's witness Daniels said Weiss had gotten nowhere with his work on DPG up to the Kratz paper. He said it inadvertently when he was discussing another subject, but, as is often the case, it is in that way that the truth comes out from an unwilling witness.

If Weiss had had any ideas of value on the subject of accelerators in the early part of 1919 and had disclosed them to Daniels, the natural thing for Daniels to do was to tell his superior, Seth Clark, about them. What accelerator to use and how to use it and how to make it were pressing problems in the Republic organization at that time, and, of course, Daniels would have told Clark of any solution of such a problem that came to him or any indication that he and his assistants were on the track of a solution.

Daniels asserted that he did tell Clark prior to the Kratz paper of Weiss's work on DPG (Vol. I, p. 222, Q. 133-5, though Clark denied it, p. 444, Q. 34-8). In that connection, that is, in stating that he told Clark of Weiss' work, Daniels said "I told him (Clark) we were doing something with it (DPG) **but I wasn't prepared to say how good it was"** (Vol. I, p. 222, Q. 135). That brief statement is a very clear index of how far Weiss had gotten by the summer of 1919 with any work he was doing with DPG. Evidently he did not know whether or not DPG was going to prove of any value, whether or not it was going to be in any way superior to TPG.

Second, as to the course of the work of the Republic Company, it was stated by Daniels that in 1918 and the first half of 1919, the accelerators which the Republic Company was using were unsatisfactory and that the need for something better was appreciated and that all through that time work on the development of TPG was in progress and that

TPG was the accelerator that looked most promising. A plant was built for the production of TPG and evidently the expenditures of the Company on the development of TPG at this time when it could so ill-afford such expenditures, were quite considerable (Vol. I, p. 210-2, Q. 53-62). It is inconceivable that the work would have taken this course if the chief chemist, Daniels, and one of his assistants, Weiss, had known that DPG would have been a much better accelerator for them to use. Had that been the case, the company's activities and the resultant record in the X-book would have been much different.

So the work on the development of TPG ran along through the first eight months of 1919 until Daniels went back from the Philadelphia meeting after hearing the Kratz paper. Then the whole condition of affairs changed abruptly (Vol. II, p. 1005, Q. 17-21). Daniels showed Weiss Dr. Kratz's figures which he had copied at the meeting and told him that it looked "as though DPG had a great deal on TPG," and that he "wanted some work done on DPG" (Vol. I, p. 218, Q. 106-10). The X-book shows the immediate effect of this direction by Daniels to Weiss to do some work on DPG. Beginning immediately after that conversation in the first half of September, 1919, and running on through the balance of September, through October, through November and through December, there was a succession of tests with DPG following one another at brief intervals throughout that entire period.

To complete the picture of the effect of Dr. Kratz's paper within the Republic plant, reference should be made to the letter forming Exhibit F (Vol. II, p. 845). Another chemist in the employ of the Republic Company by the name of Stevens was sent to New York in the fall of 1919 after the Kratz paper to make a further and more thorough investigation of the chemical literature with reference to DPG (Vol. I, p. 224-5, Q. 143-153). Evidently he wrote back to Daniels some information about TPG and Daniels thought any time that Stevens devoted to TPG was wasted, so Daniels put a

postscript on a letter he wrote to Stevens on December 1, 1919, in which he said:

> "On re-reading your letter I'm not sure but that you are spending a little too much time on *tri*phenyl. Remember we are thru with that. *Di*phenyl is the king pin now."

Thus for a period of from six to ten months after the date of invention claimed for Weiss, the Company went along with work on TPG and devising and erecting a special plant for the manufacture of TPG. Then, with the reading of the Kratz paper, all of this expensive work, undertaken after Weiss's alleged invention, was relegated to the discard and the Chief Chemist said "we are through" with TPG. In those circumstances it must be that it was the Kratz paper of September, 1919, and nothing else that caused Daniels to write on December 1, 1919, that DPG "is the king pin now."

Third, the same conclusion that Weiss's work with DPG prior to September, 1919, was productive of nothing of value is arrived at on consideration of the X-book records. There are but two recorded tests to be considered for those two are the only ones that bear dates prior to September, 1919; the test with the changed date cannot, on this record, be considered as a *pre*-Kratz test.

The two tests referred to are tests of shoddy compounds, the same or closely similar to other tests either using a different accelerator or no accelerator at all, and from the figures noted as to the tensile strength and elasticity of the products obtained, it is evident that at the time these tests were made no one who studied the results or examined the record of them would have concluded that the accelerator used offered any advantage over other accelerators then available. This is set forth at length by defendant's witness, Bridgewater, on pages 493 to 502 of Vol. I. of the record and the exhibits referred to by him; his testimony shows definitely that these two recorded tests by Weiss on shoddy compounds could not have indicated to Weiss any value in DPG as an acccelerator. That is doubtless the

reason why there is no record in the X-book of any test by Weiss or any one else with DPG at any time between March 4, 1919, and the reading of the Kratz paper in September, 1919. Instead, the Republic Rubber Company was working throughout this period on the development of TPG and a commercial plant for the manufacture of TPG for use as an accelerator in the Republic factory.

Weiss came very close to admitting the truth of what Bridgewater said. In the *National* case, while testifying about these shoddy tests, Weiss said (p. 229):

> "My first thought then, after I prepared diphenylguanidine in a quantity that I could test out, was to see how it would work on a shoddy compound, and I prepared a shoddy compound and tested that out, and found from the results, though, that *it was not to any degree much better than triphenylguanidine.*" (Emphasis ours.)

He tried to modify this statement as much as he could in this record (Vol. I, p. 173-4, Q. 411-6), but it was and is impossible for him to get away from the fact that he once gave as his opinion that these shoddy tests indicated that DPG "was not to any degree much better than TPG".

All this evidence was considered by the District Court and its conclusion recorded in the opinion was that these tests which Weiss claimed to have made and which are recorded in the X-book "show no marked superiority of DPG over TPG" (Vol. I, p. 691).

For these three reasons we assert with the utmost confidence that all of any work Weiss may have done with DPG prior to the Kratz paper was wholly inconclusive. It gave him no knowledge of the value of DPG as an accelerator. Had nothing been done at that time by Kratz, Weiss and the rest of the staff of the Republic Company would have gone on with the use of thio and the development and use of TPG without giving further thought to DPG. Instead, however,

Weiss came into immediate possession, through Daniels, of Dr. Kratz's definite statement that DPG was many times more active than TPG, (Vol. I, p. 217-8, Q. 102-4) and because of that there was immediate activity in testing DPG time and again throughout the next few months and recording the tests in the X-book. This, we say, is the conclusion which should be reached if all the testimony of Weiss and the other witnesses for plaintiff were accepted without questioning its reliability.

The conclusion that all the work Weiss claims to have done prior to the Kratz paper was wholly inconclusive and led him to no results of any value, is the conclusion reached by the Court of Appeals for the Second Circuit in the *National* case and expressed as follows:

> "We do not believe that anyone regarded DPG as a seriously preferable accelerator, until after the Kratz paper, because that chemist was plainly on this record the first to give comparative figures demonstrating the great saving of time following the use of DPG. He gave definite and persuasive reasons for the preference. We therefore incline to regard all the *pre*-Kratz work as merely experimental, and guided by no principle" (292 Fed. 559).

The District Court in this case arrived at that same conclusion, stated in the opinion as follows:

> "That a complete discovery of the qualities of DPG had then been made, seems impossible under the surrounding circumstances. The test book actually showed only two inconclusive tests by Weiss" (Vol. I, p. 694).

Therefore, and for these several reasons, we maintain that with respect to the Kratz paper alone, plaintiff has failed to sustain the burden which the law puts upon it of showing by evidence which eliminates all reasonable doubt that the alleged inventive act set forth in the patent in suit was completed before the presentation of the paper, and the claim of infringement should be dismissed for that reason alone.

SECOND DEFENSE.

The Weiss patent is invalid because of prior invention by Dr. Kratz and prior knowledge by him and his associates.

If it be held that the Kratz paper published in April, 1920, and the knowledge imparted to the rubber world by Kratz when he read his paper in September, 1919, have been antedated by Weiss, then the work on DPG which Kratz did before he prepared his paper and to develop the information included in the paper, must be considered. The proofs show that everything Weiss claims to have done before September, 1919, had been done by Kratz at an earlier date and that Kratz' work with DPG went far beyond anything which Weiss even claims to have done.

To facilitate a comparison between the utmost that Weiss claims to have done and what the proofs show was done by Kratz, we append at the end hereof a "Chronology of the Work of Kratz and Weiss" in parallel columns.

The information about accelerators contained in the Kratz paper is so comprehensive, goes into such detail, and is so accurate in that it gives definite figures for the ingredients of test compounds and for the relative activities of various accelerators, that the development of the data on which the paper was based must necessarily have been extensive, and must necessarily have covered a considerable period of time. As a matter of fact, Kratz had been a student of accelerators for over seven years (Vol. I, p. 337-341, Q. 7-18). Prior to 1914 he had been in the employ of the Diamond and Goodrich Companies as a research chemist; then on April 1, 1914, he went with the Norwalk Tire & Rubber Co. in the capacity of chemist; and then in April, 1917, he became chief chemist of The Falls Rubber Co. His first work in connection with the use of the guanidines as accelerators was in 1913 (Vol. I, p. 341, Q. 16).

In 1916, while with the Norwalk Co., Kratz prepared DPG and demonstrated its utility as a rubber accelerator by making test-slabs of exactly the same sort that Weiss made

at a later time and of exactly the same sort that rubber chemists are continually making at the present day and have made day after day for years past. Not only did Kratz make and test DPG as an accelerator, just as Weiss did later, but he did it time after time, and did it in such a way as to give him exact information as to what its accelerating value is (Vol. I, p. 344-357). This is something Weiss never did and does not claim to have done at any time prior to the Kratz paper. Kratz's work in 1916 enabled him to arrive at a figure representing the exact degree of superiority of DPG over TPG, aniline and various other accelerators. By the application of this figure he could determine exactly how much DPG it would be necessary to use to produce the same accelerating effect as would be produced by a larger amount of TPG or still larger amounts of aniline and thio.

The work Kratz did at Norwalk, which produced these valuable figures, was known to and participated in by his associates in the Norwalk Co., notably his immediate superior, Dr. Russell (Vol. I, p. 355-6, Q. 75-9 and Vol. II, p. 1019-1023) and was recorded in a carefully prepared, contemporaneous report which he left in the files of the Norwalk Co. (Ex. R, Vol. II, p. 952-6). He attached such value to the results of this work that when he left the employ of the Norwalk Co. he took with him a record of the information for his own use in his future work (Ex. Q, Vol. II, p. 945-951).

All this is covered by the testimony of Dr. Kratz, the corroborating testimony of Dr. Russell, the record of the work prepared by Dr. Kratz for the Norwalk Co., and the personal record which Kratz took with him to the Falls Co.

Then along in the fall of 1917 when Kratz was chief chemist of the Falls Co. he received a special order for one thousand inner tubes for automobile tires, and at that time he had a small supply of DPG which he himself had made. In filling this order, the one thousand tubes were made under Kratz' personal supervision, and, in doing so, the supply of DPG which Kratz then had was used, as far as it would go, that is, in the manufacture of about 300 of the tubes. That

exhausted the supply, and in filling the remainder of the order, another accelerator was employed (Vol. I, p. 358-372).

A little later, Kratz conducted at the Falls plant a series of tests with DPG closely paralleling the series of tests which he had made in 1916 at the Norwalk plant. At Norwalk most of the compounds tested by him with DPG included zinc oxide and he wanted to verify the results obtained in tests of the same accelerators in rubber compounds which did not include zinc oxide. So the tests were made over again without oxide in the compounds, and figures representing relative accelerating values of the same substances were again developed to check up the accuracy of the figures arrived at in 1916. The results obtained were so closely similar to those obtained in 1916 as to confirm fully the accuracy of the original figures (Vol. I, p. 373-5).

These tests in 1918 were made preliminary to the preparation of the paper read before the American Chemical Society in 1919. They represent but a part of the work actually done in the preparation of the paper, for the paper itself makes it obvious that its preparation involved much investigation and study of the fundamental principles of the accelerating action. With the detail of that work, however, we are not now concerned. The important fact is that in 1916 and again in 1918 Kratz made DPG and used it in the production of test-slabs of rubber in a series of comparative tests which enabled him to fix the accelerating value of DPG exactly by reference to the best known standards, namely, aniline and thio. In doing this, he did just what Weiss claims to have done in the fall of 1918 and in 1919, but he went far beyond anything Weiss claims to have done, for his work developed an *exact* value for DPG where Weiss claims only that his work showed *some* value for DPG.

Kratz' Work at Norwalk in 1916.

Kratz' work with DPG at Norwalk is covered by two sets of records, both in evidence, both in Kratz' handwriting, and both giving details of the same work. One set was pro-

duced from Kratz' personal file at the Falls Co. (Vol. I, p. 341-2, Q. 19-28; and Ex. Q., Vol. II, p. 945-951). The other set was produced from the files of the Norwalk Co. and is Kratz' formal report to his employer on this work (Vol. I, p. 348-9, Q. 48-50; and Ex. R., Vol. II, p. 952-7). It is the permanent, official record of the Norwalk Co. of work done in its laboratory and by its chemists, and its authenticity, character and purpose have never been questioned.

The purport of this record of Kratz' work is plain from the document itself; in addition, there is in the record a full discussion and detailed explanation of it by Dr. Kratz, and he was corroborated in all respects by Dr. Russell, who was his immediate superior at the Norwalk Co. and who followed his work closely and discussed it with Kratz at the time. Dr. Russell is Chief Chemist of the Norwalk Tire & Rubber Co., and he himself obtained these records of Kratz' work from the files of the Norwalk Co. and presented them at the trial of the *National* suit.

It will suffice to refer to the Norwalk company's record of Kratz' work because that was his final and official record, and also it is somewhat more complete than Kratz' personal record which constituted the notes from which the formal report was prepared.

Kratz made a series of tests with each of eight accelerators and summarized the results on the sheet of Exhibit R dated Nov. 1, 1916 (Vol. II, p. 953), which is so illuminating that it may well be quoted:

"XI/1/16 G. D. K.

Relative Catalytic Effect of Compounds Related to Sulpho Carbanilide.

The following formula was used to try out the activity of various substances more or less closely related to sulpho-carbanilide.

White Para	100
Zinc Oxide	100
Sulphur	5

The following effects were recorded and, in cases where an acceleration was produced, the amounts req'd to give a cure in one hour equal to the cure produced by 3% of S-Carb, were as follows:

Aniline	= 3.5%	
Di phenyl thio urea	= 3.0%	
Mono " " "	= 1.5%	
Thio urea	= 1.0%	(+)
Tri phenyl guanidine	= 1.75%	
Di phenyl guanidine (sym)	= 0.25%	
Mono-ph-guanidine	= 0.25%	
Urea	= 0.33%"	

The figures in this record represent relative accelerating values of various substances and were determined by Kratz in the course of a considerable number of tests with each one of the substances named, a series of test-slabs being made in each instance and the series being extended until the desired result was obtained (Vol. I, p. 345-6).

In this table of relative accelerating values, the first substance is aniline and the second is thio (diphenylthiourea). These two substances were so generally known and had been so widely used as accelerators that they served admirably as standards of comparison. Kratz said they were "well-known substances capable of general application and comparison" (Vol. I, p. 351, Q. 63) and the King publication of 1916 (Vol. II, p. 921) refers to thio as "one of the oldest accelerators known in this country." These well-known substances and each of the others in the table were used as accelerators in rubber batches compounded in accordance with an old and commonly used formula (Vol. I, p. 350, Q. 54) and in each instance a series of test-slabs was made, varying one factor after another through progressive steps until the desired result was obtained. The entire procedure was described by Dr. Kratz in ample detail (Vol. I, p. 345-352, Q. 37-63), and he was corroborated by Dr. Russell (Vol. II, p. 1019-1023).

The table referred to is that appearing on the sheet of Exhibit R dated November 1, 1916 (above quoted), where the results of the tests are summarized. For instance, the table gives 0.25 as the amount of DPG required to produce the same accelerating effect as 1.75 of TPG from which it follows necessarily that Kratz' tests taught him that DPG was seven times as strong or as active as TPG.

The sheet of Exhibit R dated October 31, 1916, (Vol. II, p. 952) gives the steps by which these results were obtained. For instance, it appears from this sheet that a series of tests were made with DPG in which the amount used in the batch of rubber was progressively decreased from 3 parts, to 1 part, to 0.7 parts, and finally to 0.5 parts, and to check the accuracy, one of the tests was made both with and without zinc-oxide in the rubber mixture. The slabs produced when using the 0.5 DPG were found to be the best so .25%, representing the 0.5 parts of DPG to 200 parts of rubber, is the figure that was put into the final table (p. 953) as the relative accelerating value of DPG.

The DPG which Dr. Kratz used in these tests he prepared himself (Vol. I, p. 354, Q. 72-3). The method by which it was prepared is described on the page of Exhibit R dated November 3, 1916 (Vol. II, p. 954). The page dated November 17, 1916 (p. 955), describes another method which was found less satisfactory, so the one described on the page dated November 3 is the one used in producing the material actually used (Vol. I, p. 355, Q. 74).

As stated above, Dr. Kratz was corroborated in his detailed description of this Norwalk work by Dr. Russell (Vol. II, p. 1019-1023). Furthermore, there is no word of any witness in any way contradicting or questioning any word of what Dr. Kratz and Dr. Russell said about this work at the Norwalk Co. It is manifest, therefore, that back in 1916 at the Norwalk Co., Dr. Kratz made test-slabs of rubber with DPG as the accelerator just as Weiss claims to have done two years later. But Kratz made many more slabs and made them in accordance with a definite plan. His plan and

procedure produced exact figures representing definite comparative values, and those definite values were recorded in a table included in a report with which his associates were familiar and which went into the files of information on accelerators kept by a rubber manufacturing company to which reference could be made at any time. Nothing in any way approaching this was ever done by Weiss prior to becoming informed of Dr. Kratz' work immediately after the Kratz paper was read.

The Tubes Made by Dr. Kratz.

This work of Kratz we have just described was done at the Norwalk Company in the late fall of 1916. He remained with that company until April 1, 1917, and then went with the Falls Rubber Company of Cuyahoga Falls, Ohio. At that time the Falls Company had no chemical laboratory and it was necessary for Kratz to organize one. Having done that, he proceeded to make some more DPG (Vol. I, p. 360-1, Q. 102-3).

In August, 1917, Kratz received an inquiry from a friend who was engaged in the sale of automobile tires in Akron. This inquiry was for 1,000 inner tubes of a special grade to compete with a cheap tube then on the market (Vol. I, p. 361-4, Q. 103-114). Immediately Kratz made an investigation to determine how he could make the tubes for sale at that low price and in that investigation he developed the formulae which appear on Exhibit S (Vol. II, p. 957).

The first of these three formulae designated "#62" was not used, the second designated "#63" was found to be more satisfactory, and the third one, designated "#63 mod." was adopted for commercial manufacture and "went into the factory" as a regular recipe under the designation of "T#8" (Vol. I, p. 365-6, Q. 120).

The two respects in which "#63" and "#63 mod." differ are important. The former includes one part of an accelerator known as "Mannose R" and the latter includes none of that substance; and another accelerator known as mag-

nesia is in both formulae but in different amounts, one part in the former and three parts in the latter.

At the time this work was under way, Kratz had on hand a supply of DPG amounting to about 30 grams (Vol. I, p. 396, Q. 258) and he decided to use it, as far as it would go, in the manufacture of these 1,000 tubes. This was done and about 300 of the 1,000 tubes were made with DPG (Vol. I, p. 368-9, Q. 134-5). When the supply of DPG which Kratz then had was exhausted, the remainder of the 1,000 tubes were made in accordance with formula "#63 mod." which in the factory was known as "T #8."

In making these 300 tubes with DPG as the accelerator, the formula used was "#63" with no Mannose-R, and with 0.2 parts of DPG. In other words, it was formula "#63" with 0.2 parts of DPG substituted for the 1 part of Mannose-R. Another statement of the same thing is that the formula was "#63 mod." with 0.2 parts of DPG included and with the magnesia content reduced from 3 parts to 1 part. This is indicated on Ex. S by the pencil notation at the right opposite "Mannose R" and the penciled square around the "1" indicating the Mannose R in formula "#63". The pencil notation in full is:

"Lagos P —2.0
M or Diphig —0.2"

"Lagos P" is an old factory name for thio and "M or Diphig" means monophenylguanidine or diphenylguanidine (Vol. I, p. 366). This pencil entry records what Dr. Kratz proposed to use in place of 1 part of Mannose R and in combination with 1 part of magnesia as the accelerator. As a matter of judgment and experience, he thought that 2 parts of thio (Lagos P) substituted for the 1 part of Mannose R would, together with 1 part of magnesia, produce the accelerating effect he desired and he knew from his work at Norwalk and the table he prepared as a result of that work that 0.2 parts of DPG would have the same accelerating effect as 2.0 parts of thio (Vol. I, p. 369, Q. 136-7; p. 393, Q. 244).

Ex. S did not go into the factory as the instruction to the workmen who would prepare the rubber for these tubes; instead, a card on which was written the formula designated "#63 mod." went into the factory (Vol. I, p. 364-5, Q. 114-120).

When the rubber for the first batches of tubes, approximately 300, was being prepared, Kratz himself went into the factory taking his supply of DPG with him and he himself introduced the DPG into the mix. He told the man who was preparing the mixture from the card giving the "#63 mod." formula to reduce the proportion of magnesia from 3 parts to 1 part, and, as the mix thus prepared was being milled, he himself put the requisite amount of DPG into it (Vol. I, p. 361; p. 366). This continued through probably two batches of rubber, sufficient to make about 300 tubes, and thereafter, the supply of DPG having been exhausted, the further procedure in the making of the 700 tubes was in exact accordance with the "#63 mod." formula, no DPG being used and the amount of magnesia being 3 parts instead of 1 part.

The 1,000 tubes thus made were shipped to the Rubber City Clearing House of Akron, Ohio, operated by a personal friend of Dr. Kratz, and the sale is proven by the papers in evidence as Exhibit T (Vol. II, p. 958-960) produced from the files of the Falls Rubber Company. The "Memorandum Shipping Order" was written by Dr. Kratz himself (Vol. I, p. 362, Q. 109) at the time of taking the order in the course of a telephone conversation with his friend and was O.K'd for shipment by the President of the Falls Company (Vol. I, p. 362, Q. 110). The other two papers in Exhibit T give the dates and quantities shipped and other data.

The fact that DPG was used in the manufacture of 300 of these 1,000 tubes was known only to Dr. Kratz so on that specific point corroboration by other witnesses was impossible. One other witness, Moore, who was then in the employ of the Falls Company, knew of the manufacture of the 1,000 tubes and tested the composition that was used in their manufacture (Vol. II, p. 1015-8). The test sheet that he made out

to record the results of his work is in evidence as Exhibit U (Vol. II, p. 961). It is dated August 28, 1917, three days after Kratz' formula sheet, dated August 25, 1917, and it identifies the composition by the same number as that used by Kratz on the formula sheet.

It has been suggested that the notation of DPG in pencil on Kratz' formulae sheet may not have been put on the sheet at the time when the other figures were put there. But Kratz said it was put there in the course of his work, that it was put there by himself, that it was put there to indicate that he used DPG in the tubes, and that he did use DPG in the manufacture of part of the 1,000 tubes.

The pencil entry on the formulae sheet reads "M or Diphig. 0.2." Kratz stated that this meant 0.2 parts of monophenylguanidine or diphenylguanidine. These two substances he knew from his Norwalk work had equal accelerating value and he said he would have used monophenylguanidine but for the fact that he did not have any (Vol. I, p. 393, Q. 246); and that what he did in fact use was diphenylguanidine (Vol. I, p. 361).

The amount of DPG used in these tubes was small, but DPG was used, and the cure was made in 35 minutes, and when the supply of DPG was exhausted it was necessary to triple the quantity of the other accelerator, magnesia, which was used to the extent of 1 part in the "No. 63" formula and then increased to 3 parts in the formula "No. 63 Mod." The very fact that Kratz's supply of DPG was limited probably made him use it in as small a proportion as would suffice. The actual amount of DPG namely, 0.2 parts, is equal to about 0.06% on the rubber content of the formula. This percentage is a close approximation of the proportion of DPG given in the Kratz paper, which is 0.075. Kratz used the DPG in that small amount because he knew from his Norwalk work that DPG was an "excellent accelerator" and he was guided in the selection of the proper amount of this "excellent accelerator" by the amount of "Mannose R" he had used in trying out formula # 63. Furthermore the tests

made and the samples produced by the witness McWhorter show that the amount of DPG used by Dr. Kratz was very effective (Vol. I, p. 424-438). Also, Exhibit G (Vol. II, p. 846-9) shows that this plaintiff considers DPG to be "very active when present in very small amounts" and mentions specifically the use of 0.12% in a blooming tube stock such as that used by Dr. Kratz.

It might be inquired why Dr. Kratz did not make more DPG and use it in all of the 1000 tubes and in the other products of his plant. The answer is that it would have been uneconomical because the only method of making DPG then known to Kratz or to anyone else, so far as we are aware, was the so-called laboratory method by which DPG is produced at a cost altogether too high to make its use on a large scale permissible. This is stated in the Weiss patent in suit. (Lines 31-36.) It was only when methods for the production of DPG in quantity at low cost were invented some years later that commercial use of DPG became a possibility. Here is the entire explanation for the fact that commercial manufacture of all kinds of rubber goods with DPG did not start at least as early as 1916 and 1917 and continue from then on indefinitely. It was only the lack of a commercial process of making the accelerator in large quantities and at a reasonably low price that deferred the day of commercial manufacture of rubber goods with DPG. As counsel for plaintiff have said in briefs in this suit, the idea of using DPG as an accelerator was of no value until a process of making it economically was devised; without this process, they said, Weiss's "vulcanization discovery was useless".

In the foregoing discussion we have not mentioned plaintiff's rebuttal witnesses, Shaw and Hoffman. Their testimony is so inconsequential that comment on it is scarcely necessary. They undertook to testify solely from recollection with reference to events that were eight years old, events which were so exactly in line with routine work they were doing day after day that there is no reason whatever why the

events should have impressed themselves on their recollection even if they had known about them at the time, and it may very well be that they had no occasion to know anything about them.

For a period of three or four years, Shaw was engaged day after day in measuring out certain quantities of certain ingredients of a rubber batch as called for by a sheet of instructions that was put before him, dumping the measured quantities into a receptacle and starting the receptacle on its way into the mill-room. Even if he was the man who measured out the ingredients for the rubber compound that went into the tubes for the Rubber City Clearing House, it is hardly believable that he would remember after the lapse of eight years that on one of the innumerable occasions when he performed this routine operation, Dr. Kratz told him to reduce the quantity of magnesia from the amount called for by the paper he had before him to one-third of that amount; (Vol. I, p. 366) and, of course, it may well be that on the day when this particular rubber compound was measured out, Shaw was ill or temporarily absent for any one of a variety of possible reasons.

Hoffman was one of the men operating a mill to effect the mixing of the ingredients of rubber batches and Dr. Kratz said it was he, Kratz, who put the DPG into the batch at the mill (Vol. I, p. 382, Q. 194). There were five such mills and no one has undertaken to say at which mill this particular rubber compound was mixed or what workman was operating that mill (Vol. I, p. 383, Q. 196).

Aside from these considerations, the character of the testimony of these two men is such that it carries no conviction.

We submit, therefore, that there is no occasion whatever for questioning any item of the history of the manufacture and sale of these tubes as related in detail by Dr. Kratz, particularly so in view of the conclusion of the trial Judge as to Dr. Kratz's credibility (Vol. I, p. 698).

Kratz's DPG Investigations at the Falls Co.

After the manufacture and sale of the 1,000 tubes, some months elapsed before Kratz's next work with DPG, because his assistant, Mr. Moore, left, and it was some months later that Mr. Flower joined the staff of the Falls Co. Then Kratz conducted the investigation required for the preparation of the paper which he read before The American Chemical Society (Vol. I, p. 374, Q. 158).

In "Table 1" of the paper the accelerators listed are the same as those in the Norwalk report but the tests of those accelerators were repeated. In the tests at the Norwalk Co., the standard formula used included zinc oxide, and Kratz wished to check up the Norwalk figures by reference to similar tests using a standard formula which did not include zinc oxide (Vol. I, p. 374, Q. 157).

The final figures representing the relative accelerating values as they appear in the paper may be compared with those in the Norwalk report, and it will be apparent at once that the tests at the Falls Co. gave practically the same results as the earlier ones at Norwalk. To compare them, it is necessary to multiply all of the figures given in the table of the paper by 3.5, for the basic figure in that table is 1.00 for aniline and in the Norwalk report it is 3.5, as is done in the following table:

	Activities given in Table in Paper	Figures in Paper multiplied by 3.5	Norwalk Tests
Aniline	1.00	3.5	3.5
Urea	0.250	0.875	0.33
Thiourea	0.300	1.050	1.0
Monophenylthiourea	0.450	1.575	1.5
Diphenylthiourea	0.850	2.975	3.0
Monophenylguanidine	0.075	0.262	0.25
Diphenylguanidine	0.075	0.262	0.25
Triphenylguanidine	0.500	1.750	1.75

This shows how closely the two sets of figures correspond; there is no difference of any consequence except in the case of urea, the explanation for which is unimportant in this connection.

Prior Invention and Prior Knowledge.

These facts making up the history of Kratz's work fully sustain the defenses of prior invention and prior knowledge. Whatever invention there was in ascertaining the serviceability of DPG as an accelerator was achieved in its entirety by Dr. Kratz at Norwalk in 1916.. The so-called invention was completed by Kratz at that time. Because of that, any one who made the invention thereafter was not the first inventor, and if a patentee is not the first inventor his patent is void. This Court has reiterated that proposition at brief intervals over the past 100 years, the most recent instance being in Alexander Milburn Company vs. Davis-Bournonville Company, 270 U. S. 390-402.

Dr. Kratz made DPG in the fall of 1916 at Norwalk in the manner fully described in the official record prepared by him, and he used that DPG as an accelerator in the proportion of 1½%, .5%, .35% and .25% of the rubber in making successive groups of rubber test-slabs (Vol. II, p. 952-6). The mixture in which he used the DPG consisted of 200 parts of rubber, 200 parts of zinc oxide, 10 parts of sulfur, and the DPG, and the mixture was cured in 60 minutes at a temperature corresponding to a pressure of 50 pounds of steam, all as shown by the record he made (Vol. II, p. 952). This was a very usual formula for a rubber batch and the time and temperature of the cure were also quite usual (Vol. I, p. 350, Q. 54-5). By this procedure he determined that with this time and temperature of cure and this proportion of sulphur, it was best to use .25% of DPG, the best rubber being produced from the mixture designated "V" on the record of these tests (Vol. II, p. 952) consisting of 200 parts

of rubber, 200 parts of zinc oxide, 10 parts of sulphur and 0.5 parts of DPG (Vol. I, p. 351-4, Q. 63-8).

This was a complete demonstration of the accelerating value of DPG within the rules laid down by this Court.* The rubber produced was as well cured as a similar mix in which 3.5% of aniline or 3% of thio was used as the accelerator; this fact is stated on the next page of the record (Vol. II, p. 953), and all rubber men of that day knew how to use aniline and thio as accelerators (Vol. I, p. 214, Q. 78-82; p. 229, Q. 6-8; p. 298, Q. 11; p. 411, Q. 337; and Ex. L, Vol. II, p. 920-3). Thus the demonstration of the value of DPG as an accelerator was complete in all respects and because there was this complete demonstration, the act of invention was complete and any later inventor was not the first inventor.

The authenticity of these records and the reliability of Dr. Kratz's testimony about them has never been questioned.

Furthermore, this plaintiff is barred from raising any question here as to the sufficiency of these records and Dr. Kratz's testimony about them as proof of completion of the invention, because records and testimony of the same character, though much less convincing, are presented by plaintiff in proof of completion of the invention by the patentee at a later date.

There is no possible theory on which it can be asserted that the evidence before the Court *does not* show completion of the invention by Kratz at Norwalk in 1916 and *does* show completion of the invention by Weiss at Republic in 1918 or 1919. These two men, Kratz and Weiss, occupied identically the same position in two different rubber plants; they both worked in the laboratories of those plants; their work with DPG included making test-slabs of rubber in a testing machine; and both men recorded their tests in official record books of their companies. The difference between them is that Kratz's work moved steadily forward to a definite and useful conclusion, expressed mathematically in

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* *Coffin* vs. *Ogden*, 18 Wall. 120-124; *Egbert* vs. *Lippmann*, 104 U. S. 333-337; *Clark Thread Co.* vs. *Willimantic Co.*, 140 U. S. 481-489.

terms of relative accelerating values of different substances, whereas Weiss's work lacked all the elements of continuity and progress and had achieved nothing at the time the Kratz paper was published.

The views we have expressed in the foregoing coincide precisely with the conclusions reached by the Court of Appeals for the Second Circuit in the *National* case and expressed so pointedly in its opinion. The opinion includes the following:

> "Dr. Kratz invented whatever Weiss did before the latter had any concept of invention. Therefore Weiss was not the 'first, sole, true and original inventor', as the bill asserts" (292 Fed. 558).

The opinion goes on to state that even if it were accepted that Weiss did all that he ever said he did and at the times when he said he did it, still:

> "we find on what we regard as the clearest evidence that Dr. Kratz did the same thing in 1916" (292 Fed. 559).

Furthermore, there was *knowledge* of the alleged invention prior to the earliest date claimed for Weiss which requires that the Weiss patent be held invalid. The Patent Statute provides for patents for inventions which are "not known", and the fact is that what Weiss describes as his invention was known. It was known to Dr. Kratz from the fall of 1916 on. He has testified to that in detail and supported his testimony with records, and neither the records nor Kratz's credibility have been questioned. That alone is sufficient, for this Court has held repeatedly that knowledge by a single individual is sufficient. But the knowledge was not limited to a single individual. Certainly it was shared by Dr. Russell, the associate and superior of Dr. Kratz in the Norwalk Company. He and Kratz have both testified that Russell had full knowledge of the value of DPG (Vol. I, p. 355 and Vol. II, p. 1019-1023) and no one has questioned

the reliability of the testimony of either. So though knowledge by one person is sufficient under the authorities, this knowledge was possessed by two that we know of. One may reasonably assume that what Dr. Kratz did at Norwalk and recorded in the official records became known to the officials of the company or at least to such of them as were directly interested in the conduct of the business. But the requirement of the law in establishing this defense of prior knowledge was more than fulfilled when it was shown that the knowledge was possessed by Dr. Kratz and Dr. Russell.

In *Coffin* vs. *Ogden*, 18 Wall. 120, this Court said:

> "The prior knowledge and use by a single person is sufficient. The number is immaterial."

Also, in *Egbert* vs. *Lippmann*, 104 U. S. 333, this Court said on page 336:

> "We remark, secondly, that, whether the use of an invention is public or private does not necessarily depend upon the number of persons to whom its use is known. If an inventor, having made his device, gives or sells it to another, to be used by the donee or vendee, without limitation or restriction, or injunction of secrecy, and it is so used, such use is public, even though the use and *knowledge of the use may be confined to one person.*" (Italics ours.)

Also, in *Hall* vs. *Macneale*, 107 U. S. 90, this Court said at page 97:

> "The construction and arrangement and purpose and mode of operation and use of the bolts in the safes were necessarily known to the workmen who put them in."

In the recent case of *Alexander Milburn Co.* vs. *Davis-Bournonville Co.*, 270 U. S. 390, the patent in suit was held to be invalid solely by reason of knowledge by another applicant for patent shown by his application filed prior to the filing of the application for the patent in suit. The first applicant described in his application a construction em-

bodying the invention of the patent in suit but made no claim to that construction and asserted no particular value or merit for it. However, the mere fact that he described such a construction was held to establish knowledge by him of the invention of the patent in suit at a time prior to the earliest date which the patentee of the patent in suit had established. The Court said (270 U. S. 401):

> "We see no reason in the words or policy of the law for allowing Whitford to profit by the delay and make himself out to be the first inventor when he was not so in fact, when *Clifford had shown knowledge inconsistent with the allowance of Whitford's claim*". (Italics ours.)

See also:

Kendall vs. *Windsor,* 21 How. 322.
Pennock vs. *Dialogue,* 2 Pet. 1.
McClurg vs. *Kingsland,* 1 How. 202.

Finally, assume for the purpose of extending the argument further, that all Kratz did at the Norwalk Rubber Company in 1916 and at the Falls Rubber Company in 1917 fell short of completion of the invention. Even so, there can be no question but that conception of the idea of using DPG as an accelerator is proven by the official record of the Norwalk Company in Dr. Kratz's handwriting and dated by him, for that record gives the quantities of the ingredients, including DPG, used in the rubber mix and no one has ever questioned its authenticity. This conception of the invention prior to the earliest date claimed by Weiss should be considered in conjunction with the reading of the Kratz paper in September, 1919, and the printing and distribution of that paper in April, 1920.

The reading of the Kratz paper was a step toward publication just as is the filing of an application for patent, and the subsequent printing and distribution of the paper was a publication just as is the issuance of a patent. Both are publications; they differ only in that one is publication with an altruistic motive, whereas the other is publication for a

consideration, namely, the monopoly covered by the patent. Thus, at every step in the evolution of the invention from the initial conception of the idea, through successful trial, to full publicity, Kratz was always prior to Weiss. Kratz did everything Weiss did and more besides, and in every instance he was ahead in point of time, except that Kratz, unlike Weiss, did not attempt to monopolize the use of DPG by obtaining a patent therefor.

The diligence of one man or the other does not have to be considered because no question of diligence is presented when one man was first both in the conception of the invention and also in giving it to the public. Furthermore, it would obviously be impossible for plaintiff to argue that Weiss was diligent and Kratz was not.

The conclusion reached by the Circuit Court of Appeals for the Second Circuit in the *National* case on this aspect of the case is expressed as follows (292 Fed. 559):

> "It follows that, taking this patent at the patentee's own value, and accepting, for purposes of decision only, his view of what he invented and how he embodied that invention, Dr. Kratz and associates were ahead of him in every step. Therefore, on this record, they were the inventors (if any patentable invention exists), and not Weiss.

See also *Twentieth Century Mach. Co.* vs. *Loew Mfg. Co.*, 243 Fed. 373, 386, in which the Court of Appeals for the Sixth Circuit said:

> "And as matter of law we see no difference between the right of a defendant to show the time of conception of *an unpatented anticipating device*, as also diligence in reducing it to practice, and the right of a plaintiff to do this in respect of a patented device. We conceive this to be the necessary effect of section 4886 and section 4920, paragraphs second and fourth, of the Federal Revised Statutes; and these statutory provisions seem to have been substantially complied with in the second and third paragraphs of the answer when read in connection with the eighth paragraph. It cannot be that a patentee

can escape the defenses either that he 'unjustly obtained the patent for that which was in fact invented by another, who was using reasonable diligence in adapting and perfecting the same' (second par. § 4920), or that 'he was not the original and first inventor or discoverer of any material and substantial part of the thing patented' (fourth par. Id.), *whether the anticipating object is patented or unpatented.* The statute makes no distinction in this regard; it is the fact of prior invention, not the nature of the right under which the invented device is held, that the statute treats as a defense. As Judge Colt said in Automatic Weighing Mach. Co. *vs.* Pneumatic Scale Corp., *supra,* 166 Fed., at 301, 92 C. C. A., 219 (C. C. A., 1):

"No sound reason has been advanced why the doctrine of diligence should not apply to a patentee as well as to an inventor who has not secured a patent. On the other hand, any such distinction in favor of patentees is not in harmony with the patent laws." (Italics ours.)

See also

Lowe vs. *Pacific Gas & Elec. Co.,* 2 Fed. (2d) 157.
Automatic Weighing Machine Co. vs. *Pneumatic Co.,* 166 Fed. 288, C. C. A., 1st Cir.
Christie vs. *Seybold,* 55 Fed. 69, C. C. A., 6th Cir.

Secrecy and Abandonment.

Plaintiff attempts to make answer to the proposition that Dr. Kratz completed the invention at Norwalk in 1916 and that he and Dr. Russell had knowledge of the invention from that time on, with a claim of secrecy and abandonment. As to secrecy, the fact is that Dr. Kratz's work with DPG at Norwalk in 1916 was recorded in the official records of the laboratory of that company. All this work was known in its details to his immediate superior, Dr. Russell (Vol. I, p. 355-6, Q. 75-9; Vol. II, p. 1019-1023), and, of course, the officials of the company had access to these company records. Also, Dr. Kratz left the employ of the Norwalk Company a few months after doing this work with DPG, and

entered the employ of the Falls Rubber Company in Ohio, and when he went there he took with him his own cards (Vol. II, p. 940-51) on which were recorded exactly the same information as appears on the Norwalk reports; in fact, the cards formed the notes from which the permanent record was prepared (Vol. I, p. 349, Q. 49).

So from this much alone, it is apparent that the completion of the invention by Dr. Kratz at Norwalk in 1916 spread at once to Dr. Russell in the Norwalk Company and then to the Falls Rubber Company out in Ohio, and in both companies the information was available at least to the officials if not to other employees. Certainly it spread to some of the other employees of the Falls Co., for in the summer of the following year we find two of these employees collaborating with Dr. Kratz in the preparation of his paper.

But most important of all, the publication of the Kratz paper was publication of the most thorough kind of the item of information which is of importance here, namely, that DPG is far more active as an accelerator than TPG.

In such circumstances it seems to us to be absurd for one to even raise an issue of secrecy. There is no evidence before the Court of any effort on the part of anyone to maintain in secrecy the fact that DPG was a particularly active accelerator, and if there were such evidence it should pale into insignificance before the actual fact that the idea did spread to some extent and then was made public to all the world.

As to abandonment, there can be no abandonment of a completed invention such as will permit some other inventor to patent and monopolize that invention. The only possible abandonment of a completed invention is abandonment to the public. That is so because it is a fundamental requisite of a valid patent that the patentee shall be the first inventor, and if the invention was completed by some one else at an earlier date, then the patentee is not the first inventor and his patent is void.

In view of what Kratz did with DPG, his work at Norwalk in 1916, the comprehensive and informative records he made of that work, taking a copy of that record with him to

his new employment, making use of DPG in commercial manufacture there, making check-up experiments preparatory to writing his paper, and then writing, reading and publishing the paper, it would seem illogical to a degree to assert that he abandoned the invention at any time in that series of events. But if there was any abandonment at any stage of the way, it was abandonment of a completed invention, completed in 1916 at Norwalk, and any such abandonment was abandonment to the public which made the invention open for use by anyone.

Evans vs. *Eaton,* 3 Wheat. 454, 483, 513.
Consolidated Fruit Jar Co. vs. *Wright,* 94 U. S. 92.
Planing Machine Co. vs. *Keith,* 101 U. S. 479.
Pickering vs. *McCullough,* Federal Case No. 11,121, 3 Ban. & A. 279, (affirmed 104 U. S. 310).
Shoup vs. *Henrici,* Federal Case No. 12,814, 2 Ban. & A. 249.
Harbridge vs. *Perrin,* 295 Fed. 927.

Plaintiff claims to find support for its allegation of secrecy in the cross-examination of Dr. Kratz and this will have to be discussed at length, particularly in view of the comment thereon by the Court of Appeals in this case. The answer to which plaintiff attaches most consequence is that given by Dr. Kratz to x-Q. 329 (Vol. I, p. 409). Detached from all else in the case, this answer might seem at first to have some significance, but in fact it has not, and when taken with what precedes and follows so as to understand accurately the idea Dr. Kratz meant to convey, it becomes of no consequence. Practically no attention was paid by any one to this portion of Dr. Kratz's cross-examination up to the time of the argument in the Court of Appeals when some reference was made to it and the presiding Judge of the Court of Appeals, considering the answers to cross-questions 329 to 334 detached from all other testimony, and finding himself unable to understand the technical matters involved in this suit, (Vol. II, p. 1037) gave to those answers a meaning far removed from anything Dr. Kratz intended.

In the first place, when the matter under consideration is the effect of a prior publication in a patent suit, testimony

of the author of the publication as to what he intended to disclose or what he intended to withhold is not only unimportant but is irrelevant (*Badische Anilin etc.* vs. *Kalle & Co.*, 104 Fed. 802-8, C. C. A., 2d Cir.). The only matters of consequence are what is contained in the paper and what a man skilled in the art would understand on reading the paper, and no amount of discussion from any source can ever take out of the Kratz paper the statement that DPG is many times as active as an accelerator as TPG, which is all that the Weiss patent in suit says.

In the second place, Dr. Kratz distinctly stated that his purpose in reading the paper was to depart from and try to break down the secrecy that had theretofore prevailed in the rubber art in connection with the use of accelerators. Not only was this his purpose and stated by him to have been his purpose, but also the fact that he accomplished this purpose is testified to by one of the principal witnesses for *plaintiff*. Dr. Kratz said he felt

> "* * * it was time some one should put some actual data on accelerators into a publication and I talked that over with Mr. Flower and we decided that we should put some of our information into the form of a paper to be presented at the next meeting of the American Chemical Society" (Vol. I, p. 375, Q. 159).

Also, he said that his paper

> "was the first open and above board discussion of accelerators that had been presented until that time" (Vol. I, p. 409, Q. 328).

And plaintiff's witness Daniels said that rubber chemists had refrained from publishing information about accelerators up to September, 1919, that Dr. Kratz's paper marked a reversal of that policy, and that since the reading of the Kratz paper rubber chemists have been much more free in giving out information (Vol. I, p. 216-7, Q. 95-6). Daniels went even further. He said that never before had he heard so interesting a paper as the one read by Dr. Kratz, nor one which gave as definite information (Vol. I, p. 216,

Q. 93-4). So instead of adhering to what had become a rule among rubber chemists, Dr. Kratz determined deliberately to depart from that rule in the hope that his action would cause others to follow, and be carried out his purpose by reading a paper which even plaintiff's witness characterized as the most interesting and informative up to that time. It is evident, therefore, that instead of secrecy, there was a revulsion against secrecy, and a determination to depart from secrecy, and an actual and effective departure from secrecy.

In the third place, when Dr. Kratz's testimony is considered in its entirety and is understood, it is apparent that it does not support plaintiff's claim of secrecy in this case, as we shall now show.

What Dr. Kratz said he did *not* give out were the factory compounds of the company by which he was employed, *i. e.*, the detailed formulae giving all the ingredients, and the amount of each ingredient. Those factory formulae a competitor could "transpose directly for practical purposes" and those he said he did not give out (Vol. I, p. 409, Q. 329). Giving out those factory formulae, he said, might be considered by his employers as "giving away company secrets" (Vol. I, p. 409, Q. 327). But, he said he gave out "two tables of substances which we pointed out were excellent accelerators" (Vol. I, p. 410, Q. 332). He said his idea was to "give enough information so that any reputable chemist would be guided by the information in the paper" (Vol. I, p. 409-410, Q. 329).

Those few quotations from his testimony show the line of demarcation precisely. The exact detailed practice then being followed within the plant of the company where Kratz was employed, he did not include in his paper because he felt he should not; but he had decided in his own mind to try to bring about an "open and above board discussion of accelerators" (Vol. I, p. 409, Q. 328) so he gave out "two tables of substances which he pointed out were excellent accelerators" (Q. 332) and a typical recipe in which he had used those accelerators (Vol. II, p. 837 and 838).

In that situation, the only question that can arise is whether or not the item of knowledge under discussion in this suit is included in what was given out. On that there seems to us to be no room for question for the paper contains not only the unmistakably clear statement of

> "the great difference in activities of mono- and di-phenylguanidines, when compared with that of tri-phenylguanidine" (Vol. II, p. 830),

but also figures expressing exactly the magnitude of the difference (Vol. II, p. 838).

That, we think, should dispose of the matter. But there is more.

Finished rubber articles differ in quality over a wide range and through almost infinite gradations; for instance, the extremely tough, relatively inflexible, and inelastic automobile shoe, on the one hand, and the frail, flexible, elastic inner tube on the other. Also, raw rubber exists in various qualities, the different qualities differ in cost, and the filling materials differ greatly and variously affect the properties of the finished product. A particular factory formula for a rubber compound takes into account all of these variations in raw material, mixture and desired qualities of finished product. It is available for direct transposition for practical purposes only to produce a particular individual product. Because of its very particularity, a factory formula is less enlightening than a typical recipe, such as the recipes given by Kratz in his paper and by Weiss in his patent.

That is generally true with respect to disclosures of new properties or new availabilities of materials. It is generally more enlightening to disclose a typical recipe coupled with the statement of the principle, than it is to disclose any number of factory formulae. In that situation the most serviceable thing that Kratz could do was to state the fact of the great activity of DPG and give a recipe by which its great activity could be demonstrated, and that is precisely what he did do (Vol. II, p. 830, 837 and 838).

Years later when Weiss was confronted with the same situation, *i. e.*, disclosing the value of DPG as an accelerator, he did identically the same thing, namely, state that DPG is a particularly active accelerator, and give a recipe in which it may be used (Vol. II, p. 718).

Just such a situation as this was before this Court in *Minerals Separation* vs. *Hyde*, 242 U. S. 261, 271, in which the Court said:

> "The composition of ores varies infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case".

The qualities desired in the various rubber articles now in common manufacture vary as infinitely or more infinitely than the composition of ores. Each one presents a special problem in devising the factory formula best adapted to the production of that article.

In that situation, if Kratz in his paper or Weiss in his patent had attempted to give a factory formula accompanied by a specification of the raw rubber used and the quality of the finished article produced, such a formula would have been of *direct practical value* only to some man who perchance wanted to use the same rubber and produce a finished article of the same quality. It would have been of *real value* as a disclosure only in so far as it furnished a key to experimentation with the standard rubber laboratory machines for making test-slabs and testing them, whereby any rubber chemist could, by following standard laboratory routine, arrive readily at the precise formula he wanted to use to meet his specific and individual conditions. As Dr. Kratz said, even if he had given an exact formula for each of the substances he mentioned in his paper, he would have assumed that those who heard him "would investigate for themselves" (Vol. I, p. 411, Q. 338). But it was far better to give a table of relative values, for with them any rubber chemist could substitute the proper amount of a different accelerator in any one of his own factory formulae.

Even the circular of the plaintiff company distributed by it through the rubber industry (Vol. II, p. 846-9), though it goes far beyond the bare recipe given in the Weiss patent, makes no pretense of giving a formula which one could "transpose directly for factory purposes". It gives what it designates as "Type Compounds for Various Rubber Articles" (P. 847), and, in connection with them, names a considerable number of other ingredients and variables which the factory man would have to determine for himself with reference to what he wanted to use, what quality he wanted to produce, and what cost limitations he had to meet.

A rubber chemist furnished with a copy of plaintiff's circular giving these "Type Compounds" would not use them for factory manufacture. But he might use them and was expected by plaintiff to use them as a guide in adapting the numerous standard formulae of his own plant to the use of the accelerator recommended in the circular. Not only is this made plain by the circular itself, but also it was so stated by one of plaintiff's witnesses. Mr. Woodward, the Vice-President of the plaintiff Company, said these "Type Formulae" were "of general interest, not specific interest" (Vol. I, p. 248, Q. 51), by which he meant identically the same thing that Dr. Kratz meant when he said rubber chemists would not attempt and were not expected to attempt to use the information and recipe given in his paper by transposing "directly for factory purposes".

DPG by Dr. Kratz and the Falls Rubber Company.

We maintain also that the tubes made by Kratz at the Falls Company by the use of DPG as an accelerator and sold by the Falls Company in its regular commercial business in September, 1917, far more than two years prior to the application for the patent in suit, (*ante* pp. 67-72) constitute an instance of prior use of the claimed invention which invalidates the patent.

So far as concerns the testimony of witnesses, the use of DPG in the manufacture of those tubes and the sale of the

tubes in 1917, rests upon the testimony of Dr. Kratz alone. As we have pointed out, the DPG used in those tubes was put into the rubber mix by him and its use as an accelerator in vulcanizing the rubber of those particular tubes was known only to him. Also, we recognize the fact that proof of a prior use which suffices to invalidate a patent usually requires the testimony of more than a single witness. In this instance, however, the facts presented fully warrant the conclusion that the tubes were made and sold as Kratz said they were, and that conclusion requires that the patent in suit be held to be invalid.

The Norwalk report of 1916 (Ex. R) shows that long before the tubes were made, Kratz had a full comprehension of the serviceability of DPG as an accelerator for he had determined its exact accelerating value by reference to such well-known accelerators as thio and aniline. Also, there is no reason for doubting that he actually had some DPG in 1916 for his report shows how he made it at Norwalk and he said he made some more at the Falls Company (Vol. I, p. 361-2, Q. 103-4). Then there is the formula which was used in the preparation of the rubber compound for these tubes (Ex. S). It is in Kratz's handwriting and shows DPG to be one of the ingredients. Then there is the order for the tubes (Ex. T) made out by Kratz himself and O.K'd by the President of the company. Then there are the shipping orders of the company showing the shipment of the tubes (Ex. T). Also, there is the test sheet (Ex. U) of Kratz's assistant, Moore, who said that the tests were made by him and that the test sheet was made out in his handwriting and the sheet identifies the composition tested by the number given it upon the formula sheet.

The tubes were not the regular tubes of the Falls Co., but were a special lot of low-priced tubes made in competition with another commercial brand then on the market, as appears from the entry made by Kratz on the sheet giving the formulæ and as pointed out by Kratz in his testimony (Vol. I, p. 361-3, Q. 103-114). Kratz was the only one in charge of the compounding, he had to work out the compound himself, he added the DPG to the mixture himself, (Vol. I, p. 382, Q.

194), he took the order himself after investigating and determining that he could make the tubes at a competing price, he knew of the actual shipping of the tubes, and he knew that the tubes were satisfactory to the purchaser (Vol. I, p. 371, Q. 149-150).

These circumstances and facts were well calculated to leave an indelible impression on Kratz's memory. The matter was one for which Kratz himself was personally responsible from the time of the preliminary inquiry, through the investigation of the compounds, the taking of the order over the telephone, the mixing of the ingredients used, the addition of the DPG which Kratz himself had made, the shipping of the tubes and the satisfaction of the customer with the purchase. The corroboration of Kratz's oral testimony by records in his own handwriting, by the testimony of Moore, by the record of the physical tests, and by the sales records, was all the corroboration available, but, taken with Kratz's testimony, it is sufficient to compel belief.

In addition to all this and by way of further circumstantial corroboration, it was only a few months after these tubes were made by the use of DPG that Kratz made the series of tests of various accelerators, including DPG, which served as the basis for his paper, and the results of his tests and the tests he made at Norwalk were embodied in the paper read by him before an assemblage of the principal rubber chemists of the country.

On this point of the sufficiency of the proof of the tubes, the sole question is whether or not the Court believes, from the testimony of Kratz and Moore and the documents we have referred to, that Kratz did in fact do what he said he did in the manufacture and sale of the tubes. It is solely a question of whether or not the Court believes the tubes were made and sold as stated, and on this array of documentary evidence and corroborating circumstances it seems to us that there is no reasonable ground for doubt.

Moreover, plaintiff does not question Dr. Kratz's veracity. It offers nothing in contradiction of what he said or in disparagement of what he did. On the contrary, plaintiff has

stated specifically that it does not reflect "in any way on his credibility". In addition to that, the Judge of the District Court who observed Dr. Kratz on the witness stand and who listened to his extended examination, paid tribute to him as a man of high character whose word should be accepted without question.

The District Court said:

> "There is some documentary evidence which tends to confirm this claim of use, but even if there were none we should not feel justified in rejecting it. To do so would be to impute wilful falsehood to Dr. Kratz, and neither his interest in this case nor his manner and appearance upon the stand was such as to furnish any foundation for that imputation. His knowledge of DPG and the general circumstances make the use of it as an accelerator quite probable" (Vol. I, p. 698).

On practically identical evidence, the Court of Appeals of the Second Circuit in the *National* case said:

> "When we perceive how closely his acts in 1916 correspond with his essay of 1919, we believe his evidence, though uncorroborated, that in 1917 he made rubber tires and sold them, using DPG as the accelerator; and this is more than Weiss even claims to have done before application filed."

In a somewhat similar situation the Court of Appeals for the Second Circuit said:

> "There is no reason to doubt the testimony of the patentee as to the date of his inventive thought. While it is true that uncorroborated testimony of an inventor is to be accepted with caution * * * yet there is no rule of law that requires rejection of the uncorroborated testimony of an inventor as to the date of his conception." (*Armstrong* vs. *De Forest,* 280 Fed. 584, 590.)

Also, the Court of Appeals of the Third Circuit which rejected this defense without stating its views thereon, said in another case:

> "It is undoubtedly the duty of courts to exercise, as in nearly all cases they are careful to declare, the

utmost caution in scrutinizing and considering the testimony offered to establish a prior use. Courts have frequently taken the ground, under the particular circumstances of the case before them, that where a long time has elapsed since the alleged use, and the fact depends upon the fading recollection of a single witness, that an exhibit of the device or thing actually used must accompany the affidavit. There is, however, no hard and fast rule as to this. In this, as in other cases, the weight and effect of testimony must be passed upon, and a conclusion as to the existence of an alleged prior use will be reached if the evidence thereof is clear and satisfactory to the judicial mind." (*Sipp Electric & Machine Co.* vs. *Atwood-Morrison Co.*, 142 Fed. 149, 154; C. C. A., 3rd Circuit.)

A similar situation was presented in *Tompkins* vs. *N. Y. Woven Wire Mattress Co.*, 159 Fed. 133, 135, in which the Court of Appeals for the Second Circuit held the patent in suit invalid on the testimony of a single witness, saying:

"Is Mr. Prince's statement true? Having in mind the fact that he is an interested witness and that his statements must be established beyond a reasonable doubt, we see no way to avoid the effect of his testimony, unless we are prepared to say that he has committed willful perjury. This we cannot do. Mr. Prince appears on the record to be an intelligent, straightforward, conservative, business man. He was not testifying about events happening so long ago that the memory might well be confused and clouded by the lapse of time and a multitude of intervening events. His testimony was given in 1906 and related to transactions in 1904-5, and it was not contradicted. Though he did not produce a Regis spring he gave the names of a number of dealers to whom the spring had been sold, so that if his statements were untrue it could easily have been discovered by an examination of these persons and the defendant's books. There is nothing astonishing or inherently improbable in Prince's testimony and we cannot disregard it."

Also, in *Riley* vs. *Daniels,* (Fed. Case 11837) Circuit Judge Shipman held a patent invalid because of a prior use established by the testimony of a single witness, saying:

> "The use of satinet wicks by H. K. Sears, in 1836 and 1837, was somewhat experimental, and, if his testimony had been confined to a use in those years, would have been insufficient. But he also testifies that in January and in February, 1862, he sold ordinary tin lamps with flat woolen wicks, which he made himself, to the soldiers of the Union Army in Virginia and in the District of Columbia, and informed and showed the purchasers that woolen wicks could be used in the lamps. His testimony I believe to be true. The important question upon this state of facts is whether, inasmuch as the defendant takes the burden of proof, and must overcome by preponderating testimony the *prima facie* evidence which is furnished by the letters patent, the testimony of a single witness is sufficient to create such a preponderance." * * *
>
> "The evidence should be of such a character as to satisfy the court that the prior invention of the particular article in controversy took place. As there is no improbability from the character of the invention that Mr. Sears might not also have formed a wick from woolen cloth, and as I have no doubt that he did peddle flat woolen wicks in January, 1862, among the soldiers, I am of opinion that the patentee was not the first and original inventor of the patented article, and that the bill should be dismissed."

As to the sufficiency of a single instance of prior use when the proof of it is adequate, there can be no question in view of the decisions of this Court in the cases to which we have referred on pages 77 and 78 hereof.

In such a case of prior use as that presented here, one might reasonably inquire why the prior use did not persist, so that as it continued, more and more people would become familiar with it. In this instance the explanation is complete. Such DPG as Dr. Kratz then had available was exhausted and for him to make more by the methods then avail-

able would have involved an expense out of all proportion. It was far cheaper to use thio or some other accelerator then readily purchasable in quantity at small cost even though it had to be used in a larger proportion. DPG could then be had only in small quantity and at relatively high cost; making it by the so-called laboratory method described in the literature involved a cost beyond the possibilities of commercial manufacture as all agree and as the patent in suit states. Extensive use of DPG had to await the development or invention of a new method of making it which would produce it at a cost comparable with that of other accelerators and eventually that was done by Weiss and others.

But in this one instance, DPG was used in the regular commercial production of tubes for automobile tires and the tubes were sold in the regular course of trade and were found to be satisfactory. Under the authorities cited, such a use is sufficient to invalidate a subsequent patent.

FOURTH DEFENSE.

Weiss is Not an Original Inventor.

Up to this point our discussion has proceeded on the assumption that Weiss conceived the idea of using DPG independently. We say this is not the case. Weiss got the suggestion of the use of DPG as an accelerator from an entry which had been made in the X-book, before Weiss entered the employ of the Republic Company, by Baldwin, a predecessor of Weiss as a chemist of the company. The proof of Baldwin's use of DPG rests upon a certain record, and that record is the very same X-book which Weiss presents in proof of his assertion of invention, the only dated record evidence Weiss has.

This is particularly important in this case because plaintiff's whole claim rests upon proving beyond a reasonable doubt that Weiss made the invention in issue before Septem-

ber, 1919, and because, except for the X-book alone, its proof consists entirely of the recollection of witnesses of events which occurred many years before they testified.

On page 2005 of the X-book, (Ex. 10, Vol. II, p. 731) in the first column, is the record of a test including the use of DPG. The date entered at the bottom of the column is February 22, 1917. The name "DIPHENYLGUANIDINE" is recorded in the column of substances in printing of a distinctive style. The title at the top of the page is inserted in that same printing as "ACTION OF ORGANIC ACCEL."

All the rest of the entries on this page were made by Weiss, as he himself acknowledged (Vol. I, p. 174-5, Q. 417-428). Those entries range in date from June 13, 1918, to February 21, 1919.

This X-book was the official record of the work done in the laboratory of the Republic Company. When Weiss entered the employ of the company in the fall of 1917, there were only a few entries in the book and as he began at once to study the chemistry of rubber in general and accelerators in particular, it must be that he examined with care such entries as had then been made in the X-book.

We maintain that there, in that X-book, right under Weiss's eyes all through 1918, in this book in which he entered many tests of his own, was the record of a test of a rubber compound containing diphenylguanidine as an accelerator. Weiss saw it at the time, he must have seen it, particularly when he made the other entries on the same page; but in the years that elapsed up to 1923 when the *National* suit was tried during which he did a great deal of work with DPG and devised a process of making it, he forgot that the entry of DPG was there in the X-book and imagined that he himself was the first to propose using it.

At the trial, plaintiff's witnesses said this entry in the first column on page 2005, or the essential part of it, was not there at the time when Weiss made the other entries on the page or at any other time while Weiss was in the employ of the Republic Company. This appears in Weiss's answers

to questions 499 to 502 on page 192. The first of those answers is typical of Weiss; in one answer, he said definitely that certain figures were not in the X-book and that it was his recollection that they were not in the book and that he did not recall exactly whether or not they were in the book. Taking all the answers together, one can only say that Weiss denied having any recollection of seeing on page X-2005 in 1918 or 1919 the entry of the test recorded in the first column.

As a matter of fact, this entry was there and was put there by Baldwin in February of 1917. Baldwin was definite and positive in his identification of the X-book and the entries made by him in the early pages of the book (Vol. I, p. 312-5). As to the entries on page 2005, he said that the number 2005, the title "ACTION OF ORGANIC ACCEL.", the reference "(X-2004-C)", the name "DIPHENYLGUANIDINE", all the figures in the first column, the letters "N. G.", and the date "2-22-17" were all put on that page by him, and that he was absolutely certain that he put all of them on that page on or about February 22, 1917.

Baldwin is corroborated by the record evidence of the X-book, the record which plaintiff presents in support of Weiss' assertion of invention, and by the witnesses Brill and Clark. Brill was employed by the Republic Company from late in 1910 until June, 1917. During that period, the Republic Company was using accelerators but those available were not entirely satisfactory, and Brill was making systematic efforts to develop others (Vol. I, p. 298-9, Q. 10-13). At first, Brill did most of the work himself, but during the summer of 1916 he was put in charge of the laboratory and development department and that work left him with insufficient time to carry on this investigation.

Brill talked the situation over with Clark and it was concluded that the Company should employ a chemist for the particular purpose of trying various organic materials in rubber compounds in the search for more satisfactory accelerators (Vol. I, p. 300-1, Q. 14; p. 441).

Baldwin is the man who was hired to do this work. He

started about the middle of 1916 under the guidance of Brill, trying various organic substances; and Brill was very careful to impress upon him the importance of keeping complete records in the X-book (Vol. I, p. 302-5).

A definite plan had been decided on for Baldwin's work. It was getting to be generally recognized among rubber chemists at that time that the best accelerators were organic substances which are basic and rich in nitrogen, and Baldwin was to experiment with organic substances of that character (Vol. I, p. 441, Q. 14). So Brill and his associates selected a number of such substances and directed Baldwin to test them and study the literature for suggestions of other promising substances and try them. The group of guanidines was one of those on the program of substances to be tried by Baldwin; Brill could not say specifically from memory after the lapse of so many years, that he instructed Baldwin to make tests with DPG but he did recall that the guanidines had been mentioned in the literature of rubber vulcanization as possible accelerators, and that his discussions with Baldwin of the work which the latter was to do included consideration of the guanidines (Vol. I, p. 308-9, Q. 43-4).

So, making test-slabs with rubber compounds containing guanidines as accelerators, and specifically DPG, was directly in line with the work for which Baldwin was hired and which he did for a period of over a year from the summer of 1916 on. Brill's statement of this (referring to the X-book) is as follows:

> "I would say that it would be very peculiar if, in going over this book, I did not find some work by Baldwin, in which he had tried these different guanidines. DPG would be one of them" (Vol. I, p. 308-9).

This is all corroborated by Mr. Clark (Vol. I, pp. 440-3) and he, like Brill, stated that the record of a test of DPG in the X-book is just what he would expect to find there because that would be in line with the work for which Baldwin was hired (Vol. I, p. 443, Q. 26-7).

The chemicals which Baldwin used as accelerators in the course of his tests were either prepared by Baldwin or were purchased from any one of several chemical supply houses. The X-book indicates at the bottom of page X-2000 (right) (Vol. II, p. 726) that one substance was obtained from the Holland Aniline Company and where directions for making another substance were obtained, and Brill, Clark and Baldwin told of the purchases of certain of the substances tried (Vol. I, p. 442, Q. 18-20; p. 304, Q. 30-32; p. 311, Q. 18-20). As to DPG, that could have been and probably was obtained from the house of Eimer & Amend as is shown by the testimony of Dr. Amend (Vol. I, p. 291-2, Q. 11-16).

In contending that the record of a test with DPG on page X-2005 was not in the X-book before Weiss' alleged conception of the idea of using DPG, plaintiff takes a position contrary to reason as well as to the evidence. The testimony of Baldwin and Brill and Clark is corroborated by various circumstances of convincing force. Also, in claiming that something which now appears in the X-book was not there on the date it bears and was not there for a long time thereafter, plaintiff is impunging the veracity and value of the very book it relies on and must rely on to prove its own case, the only dated record evidence it has of Weiss' work prior to the Kratz paper.

Weiss admitted that he made all of the entries on page X-2005 other than those we have stated were made by Baldwin, and in particular, that he wrote "On Shoddies" which appears at the top of the sheet directly under the title printed by Baldwin (Vol. I, p. 174, Q. 417, *et seq*). It is beyond belief that Weiss would have written "On Shoddies" at the top of the sheet under the line for the title unless there was something already written on the title line, and what was written on the title line was then just what is there now, the title put there by Baldwin.

There must have been something in the first column on page 2005 just as there is something in the first column

on the pages immediately preceding and following in the same characteristic printing of Baldwin. All of Baldwin's work was recorded on the first ten pages; each of pages 2001 to 2010 inclusive contains entries by Baldwin and the dates are all early in 1917. Furthermore, it is improbable that the first column of page 2005 was blank when Weiss made his entries on that page and that Weiss began a record of his own tests in the second column.

Weiss identified as his own handwriting the entries of the names "D Shoddy", "Z Shoddy", "C Shoddy", etc., appearing in the column of names of substances at the extreme left of page 2005 (Vol. I, p. 174, Q. 418). The first of these, "D Shoddy", is entered on the second line below the printed name "Guayule" so that something must have been entered on the first line to have caused Weiss to put "D Shoddy" on the second line, and what must have been there is just what is there now, namely, "DIPHENYLGUANIDINE".

Weiss was unable to recollect what entries were in the first column of figures and could not say whether or not there were any entries in that column, and he admitted finally that he did not recollect anything about it (Vol. I, p. 195, Q. 522).

It would be futile for anyone to claim that there was nothing in this column for certainly something must have been recorded on the page when Weiss made his entries there since otherwise he would not have written "On Shoddies" in the line below the title line, and he would not have left so much space below the printed word "Guayule" in writing "D Shoddy". So evidently there was some test recorded there. It must have included figures in the first column for figures and there must have been an accelerator used in the compound because the book was a record of tests with accelerators.

Plaintiff has asserted that a test was recorded in that first column but that "diphenylguanidine" did not appear in the column of substances. In fact, plaintiff has tried to make some point of the fact that the figures in the first column add

up to 101, as though whatever entry was there initially did not include one part of an accelerator and the original total was 100. But compounds adding up to 101 and 102 appear all through Baldwin's work recorded on the first 10 pages of the X-book. Also, there is no evidence of a change of an original total of 100 to the present total of 101. Also, the book shows no evidence of any change having been made where "diphenylguanidine" now appears. Also, if "diphenylguanidine" had not appeared there at all, Weiss would have written "D Shoddy" further up.

Then there is the evidence of the handwriting expert, Mr. Haring. He said he could find no evidence of any alteration on page 2005 of the X-book (Vol. I, p. 456, Q. 47-48). Also, he made a study of the printing of "diphenylguanidine" in comparison with the printing of the title "Action of Organic Accel." and the printing of others of Baldwin's entries and showed in a most interesting, and, we think, most convincing manner, that this word "diphenylguanidine" is entered in the same characteristic printing as the rest of Baldwin's work (Vol. I, p. 452-6, Q. 26-46). Even to the layman, it seems apparent that the entries were all made by the same hand. The printing is rather distinctive, particularly with respect to the letter "U" and the letter "N", as was pointed out by Mr. Haring, and it seems to us that even without the aid of a student of handwriting it would take very strong evidence to convince one that this word "diphenylguanidine" was not written in the book at the same time and by the same person who wrote "Action of Organic Accel." and such other matter as that appearing at the bottom of page 2001 (right).

Some effort was made to raise a doubt as to whether this entry of "diphenylguanidine" was put in the X-book by Baldwin in 1917 by reason of the fact that page 2005 and page 2008, two pages formed by the same sheet of paper, were withdrawn from the X-book and were not in it for a considerable period of time. Who took them out does not appear. But they were recovered before the *National* trial and have been identified by witnesses for both sides as the original sheets. For this reason, their temporary absence is now of importance

only in connection with the testimony of two of plaintiff's witnesses, Woodward and Vaill. These two witnesses for plaintiff said that they examined the X-book on May 11, 1922, and that page 2005 must have been in the book at that time, because if it had been absent, they would have noticed its absence and that the page could not have had "diphenylguanidine" on it because if it had, they would have noticed that (Vol. I, p. 639-642, Nat. Rec. p. 361-2). It is sufficient to say that they were mistaken, and, of course, in any such negative testimony, one could easily be mistaken. Defendant's proofs show definitely that on that date, May 11, 1922, when Woodward and Vaill said they examined the X-book, page X-2005 was not in the book. Its absence was discovered on May 8, 1922, and it was recovered at some time after May 11th, as is shown beyond doubt by the testimony of Barrows and Young (Vol. I, p. 473-484). Furthermore, Vaill merely said that the page was "not there, as far as I recollect" (Nat. Rec. p. 362). As to Woodward, he is an interested witness and furthermore no reliance should be placed on the testimony of any one who has attempted by improper methods to influence the testimony of a witness called by his adversary in a legal proceeding, as is shown to have been done by Woodward in the interference involving Weiss' application for a patent on DTG (See Ex. VV, p. 274-6 and *ante*, p. 53-4).

Two more of the plaintiff's witnesses, Carlton and Nellen, testified that this entry of diphenylguanidine was not in the X-book, but their testimony is purely negative to the effect that they did not recollect seeing it there. As was stated by this Court in *Stitt* vs. *Huidekoper*, 17 Wall. 384, 394:

> "a witness who testifies to an affirmative is to be preferred to one who testifies to a negative, because he who testifies to a negative may have forgotten. It is possible to forget a thing that did happen. It is not possible to remember a thing that never existed."

Carlton's testimony is an excellent demonstration of this proposition; after first testifying that there were entries of *tri*-phenylguanidine in the X-book when he

first examined it, he was unable to find in the X-book any entry of *tri*-phenylguanidine made prior to the time of that first examination (Vol. I, p. 626-7). We say that all of this negative testimony should be disregarded because it is so manifestly absurd for a witness to testify simply from recollection that a certain entry was *not* in a certain place many years ago, though he has no recollection of what was there. Carlton, moreover, is another witness of questionable credibility (*ante*, p. 39-40, and Vol. I, p. 628-632, Q. 108-130).

Under all these circumstances we think it must be concluded that the entries which Baldwin said he put in the X-Book in February, 1917, were put there at that time just as they appear there now, including the word "DIPHENYLGUANIDINE." Also, Weiss must have seen that entry in 1917 and 1918 when he made his entries on that same page and the pages following and when he took charge of the book immediately after Carlton left the employ of the Republic Company in March, 1918, and if that be so, Weiss's claim made for the first time in November, 1921, that he originated the idea of using DPG as an accelerator is not worthy of belief.

Two circumstances which add force to this conclusion are that when Weiss applied for employment at Firestone and again when he applied for employment with the National Aniline Co., he made no claim that he was the originator of that idea. At those times, he was extolling what he had done in the chemistry of rubber and had good reason to extol it because he was seeking employment as a rubber chemist and was much in need of employment (Vol. I, p. 157, Q. 324-5). On both of those two occasions, instead of claiming that he originated the idea of using DPG as an accelerator, he claimed only that he had originated a process of manufacturing DPG in commercial quantities, and he ascribed to Kratz the credit for having shown that DPG is of superior value as a rubber accelerator. This does not appear in detail in connection with his application for employment with the National Aniline Co., though it is sufficiently evident that he mentioned Dr. Kratz at that time, but on his application for

employment at Firestone, he wrote, "the value of this product as an accelerator has been discussed by Dr. Kratz" and "he has shown that .08% of this product is equivalent to 1% of aniline" (Ex. C, Vol. II, p. 824; and *ante*, p. 22-24).

These circumstances, the entry of Diphenylguanidine in the X-book by Baldwin and Weiss's failure to claim that he originated the use of DPG when there was every reason for him to put forward that claim if he really had done so, fully warrant the conclusion that he did not originate that idea.

Plaintiff's counsel have heretofore treated the Baldwin experiment solely as an attempt to prove a prior use and they argue that the Baldwin test was only an unsuccessful and abandoned experiment. We do not and never have urged it as a prior use and as the test is distinctly labeled "N. G.", of course it is not one. But it does show that the idea of using DPG as an accelerator was not an original conception of Weiss. Weiss got that idea from the X-book, where it had been recorded by Baldwin and where Weiss recorded his own work after Baldwin left the employ of the Republic Company.

FIFTH DEFENSE.

The Weiss Patent Does not Disclose a Patentable Invention.

We have shown that the use of organic substances as accelerators was well known and well established prior to the earliest date claimed by Weiss. The known art was summarized in the King paper of September 1, 1916 (Ex. I, Vol. II, p. 920-3). King classified the most important of the known organic accelerators and in doing so made reference to "Urea and Such Derivatives as Guanidine." A little later, on July 31, 1917, Twiss wrote a paper on accelerators in which he pointed out that almost all of the known effective organic accelerators are basic and that there is a rough proportion apparently existing between their activity and their

alkalinity (Ex. M, Vol. II, p. 924-931). Among the compounds which he discussed is a guanidine derivative known as "amino guanidine".

Another guanidine derivative, triphenylguanidine, had also been tried and had been found to be a very serviceable accelerator. Its use is acknowledged in the patent in suit to have preceded the alleged invention, and Weiss conceded that he knew about it prior to his alleged date of conception of the use of diphenylguanidine (Vol. I, p. 134, Q. 191). Carlton said he was familiar with the guanidines as a class in 1918 and discussed them several times with Weiss (Vol. I, p. 92-3, Q. 16).

How could any chemist, knowing that the guanidines as a class were accelerators, and knowing that triphenylguanidine was an accelerator, fail to think of diphenylguanidine, the next most closely related member?

Dr. Whitby, plaintiff's expert, said that as far back as 1912, it was recognized as a general rule that strong bases of a nitrogenous character were good accelerators and that on that basis a rubber chemist would expect DPG to be an accelerator without trying it, although he pointed out that the only sure way to find out in any case would be to try the substance in a rubber compound (Vol. I, p. 83-5, Q. 183-191).

Diphenylguanidine and triphenylguanidine are so closely related that authors on organic chemistry group them together, as they are grouped in Richter's text book under the common heading "Phenylated Guanidine Derivatives" (Vol. I, p. 559-560, and p. 63, Q. 55). In fact, diphenylguanidine and triphenylguanidine are the only phenylated guanidine derivatives appearing on the page of Richter's text book from which Weiss claims to have gotten his idea of diphenylguanidine, so that it would have been impossible for him to look up the known accelerator triphenylguanidine in his book without having diphenylguanidine face him from the same page (Vol. I, p. 135, Q. 204-5).

Diphenylguanidine was considered by Kratz merely as another member of the known guanidine group, and, since

the guanidines as a group had been referred to in the literature, Kratz thought it proper to refer to various members of that group, including diphenylguanidine, and to say in his paper "We have chosen to employ only substances which have been previously cited by others" (Ex. E, Vol. II, p. 826).

Accordingly, to a chemist familiar in 1918 with the guanidines in general and triphenylguanidine in particular, the most natural thing in the world would have been to think of diphenylguanidine as usable for the same purpose, and every rubber chemist would have known that the only way to find out would be to try it according to the routine methods of laboratory testing. Of course, he would first have had to obtain his diphenylguanidine, but it could be purchased (Vol. I, p. 290-6) and there were known methods described in the literature for producing it; any organic chemist seeking to do so could have produced it by following those directions, just as Kratz and Weiss did. Having produced it, the method of ascertaining its value was a matter of laboratory routine and the use of standard test formulae.

To most of us who are not organic chemists, the complex and elongated names of the organic chemicals used as accelerators might suggest that their composition and properties are abstruse subjects shrouded in much mystery; and the tests used by rubber chemists in testing accelerators might appear difficult and complex. But the fact is that these accelerators and these test methods are but the tools of the organic chemist and of the rubber chemist. He knows them through long study and frequent use. To him they are what a gear, a lever, a crank and other mechanical elements are to the designer of machines. He picks out the proper one from among those known to him, just as the designer of machines chooses that mechanical element which will serve his purpose, and when he has no rule which will lead him to an immediate selection of the proper chemical, he, like the designer of machines, resorts to a process of trial, using the expected skill of his calling.

So, in the present case, Weiss had the group of guanidines suggested to him by Carlton (*ante*, p. 39-40). Attention was also directed to them in the review of the subject by King, published in 1916 (*ante*, p. 102). Among this group of guanidines, the next closely related member to diphenylguanidine had been used as an accelerator and its use was brought to Weiss' attention prior to his alleged date of conception, *i. e.* triphenylguanidine.

In this situation we say that the selection of the next closely-related member of this known guanidine group and the testing of this particular guanidine by the customary test methods of testing accelerators was well within the limits of expected skill of the rubber chemist, the man skilled in the art. That is what the rubber chemist is doing day in and day out, just as it is what the designer of machines and the architect of buildings is doing day in and day out, namely, selecting elements closely related to those previously used or known to be useful and making the usual tests with them, according to standard and routine test methods and formulae.

Invention is something far beyond that. It has been characterized as a "leap of the imagination," an act which involves passing over those elements closely related to the ones which have been used and therefore known to be useful, to something distantly related or wholly unrelated by reaching out into the unknown and bringing into the field of utility something which the man skilled in the art would not have supposed was available or would not have known of at all. Crediting Weiss with all that is claimed in his behalf, he cannot fairly be said to have made an invention by being led by the use of triphenylguanidine as an accelerator to think that diphenylguanidine might be an accelerator too, trying it and finding out that it is (*Smith* vs. *Nichols*, 21 Wall. 112; *Atlantic Works* vs. *Brady*, 107 U. S. 192).

When Weiss applied to the Firestone Co. and to the National Company for a job (*ante*, p. 22-24), he made no claim that this idea which he says originated with him was an inven-

tion. Shortly thereafter, in the summer of 1920, Weiss said he learned that patents had been granted for certain accelerators (Vol. I, p. 168, Q. 387-9) but still he made no claim that his alleged conception of this use of diphenylguanidine was an invention and he and his associates proceeded with the manufacture and sale of diphenylguanidine without any assertion that its use as a rubber accelerator involved invention. Another year passed by and an application covering the **method of producing** diphenylguanidine was filed in July, 1921 (Ex. QQ, Vol. II, following p. 1002).

Only in November, 1921, over three and one-half years after Weiss claims to have conceived this idea, and then only in response to the exigencies of the commercial situation, was any claim made that the suggestion of the use of diphenylguanidine as an accelerator involved invention, notwithstanding the known availability of the guanidines as a group and the actual use of triphenylguanidine. So the filing of the Weiss application occurred after a period of nearly four years during which Weiss had accepted the view that the idea was not one which he could patent.

For these several reasons, we assert that what Weiss claims to have done was not an invention. In view of the prior art, as disclosed by the King and Twiss publications, and the acknowledged prior use of triphenylguanidine, and the admittedly known availability of the guanidines as a group, it was nothing more than what one would expect from a chemist in proceeding from the known substance triphenylguanidine to the extremely closely related substance diphenylguanidine. For that reason alone the patent should be held invalid.

Plaintiff has asserted that the Weiss patent involves not only the discovery that DPG is a good accelerator, but also the discovery that when DPG is used, the rubber produced is of a superior quality. This is true only with various qualifications, (Vol. I, p. 502-6, Q. 32-4; p. 536-9, Q. 14-26), but, assume for the moment that it is broadly true. The production of better rubber by the use of an accelerator of greater

activity is only what a rubber chemist would expect, and would have expected at any time back as far as Kratz's work at Norwalk in 1916. It was one of the known principles of vulcanization, known prior to 1916, that, other things being the same, greater acceleration is productive of better rubber (*ante*, p. 11-12).

But even if that had not been a known principle, no inventive act would have been involved in ascertaining that by using the DPG whose greater activity was discovered by Kratz, a better rubber would be produced. A good analogy would be the case of a baking powder used in making biscuit; if some inventor announced that some substance not previously used for the purpose is an excellent baking powder, there would be no invention in ascertaining that by the use of the new substance in accordance with the usual procedure of mixing the ingredients and baking, a superior biscuit is produced.

As this Court said in *Stow* vs. *Chicago*, 104 U. S. 547, 550:

> "It is shown that Stead invented this device. Whether he perceived and stated all its advantages is immaterial."

This Court also said in *Lovell Mfg. Co.* vs. *Cary*, 147 U. S. 623, 634:

> "It follows necessarily that the public can not be deprived of an old process because someone has discovered that it is capable of producing a better result, or has a wider range of use than was before known."

See also

Roberts vs. *Ryer*, 91 U. S. 150.

Furthermore, the proof submitted by plaintiff to carry Weiss's date of invention back of the Kratz paper includes nothing about the comparative quality of the rubber Weiss is alleged to have made in 1918 and 1919. That was considered by plaintiff to be wholly immaterial.

SIXTH DEFENSE.

Claims 1, 5 and 9 of the Weiss Patent are invalid by reason of special matters applying to them only.

Claims 1, 5 and 9 of the patent in suit define the patented invention as involving the use of a "disubstituted guanidine". This is a broader term including not only diphenylguanidine but also all other derivatives of guanidine in which two of the hydrogen atoms of the guanidine nucleus have been substituted by other groups.

These claims are invalid because the subject-matter thereof is disclosed in a magazine article published more than two years before the patent in suit was applied for. The article referred to is an article by Du Bosc published in a French magazine entitled "La Caoutchouc et la Gutta Percha" on July 15, 1919 (Ex. O, Vol II, p. 934-9).

This article is entitled "A Study of Accelerators," and is a discussion of many different guanidine derivatives as accelerators. It is stated that the accelerators commented on are substances which the author of the article had investigated, from which it appears that the comments in the article are based upon actual tests. Well along in the article there is a reference to "other interesting guanidine derivatives which are capable of acting as vitalizers (accelerators)," and this is followed by the names of several of these guanidine derivatives together with the chemical formula for each of them and comment on some of them (Vol. I, p. 488, Q. 19 *et seq.*). Among those appearing in this list is "diaminoguanidine."

The concluding sentence of the article is:

> "As results from the above account the series of amino compounds derived from urea and cyanamide is capable of yielding vitalizers (accelerators) which are rich in nitrogen and, consequently, exceedingly powerful."

This diaminoguanidine is a di-substituted guanidine, and, therefore, this Du Bosc publication, disclosing the use of diaminoguanidine as an accelerator of rubber vulcanization at a time more than two years prior to the filing of the application for the patent in suit, is a complete anticipation of those claims of the patent which attempt to define the patentee's accomplishment by the use of this broader expression adopted for the specific purpose of covering not only diphenylguanidine but also all other guanidine derivatives which fall within the class of di-substituted guanidines.

Diaminoguanidine is what is known as an unstable substance; if prepared in the pure state it would decompose and change into something else. As chemical dictionaries put it, this substance "does not exist in the free state" (Vol. II, p. 810, side folio 100).

When dealing with such substances, chemists know perfectly well what to do. They mix them with something else which does not affect their serviceability but does maintain them stable. In the case of an unstable amino-guanidine, they mix with it the necessary ingredients to form the bicarbonate salt of the aminoguanidine.

Not only was this common knowledge among chemists, (Vol. I, p. 491, Q. 24) but it is specifically stated in the literature of this art. Thus, an article by Twiss refers to the use of aminoguanidine as an accelerator, that is, mono-aminoguanidine instead of di-aminoguanidine, and states that inasmuch as that substance is unstable, it was used in the form of a bicarbonate salt (Vol. I, p. 491, Q. 24). Twiss said (Ex. M, Vol. II, p. 928):

> "I have also found that the unstable base aminoguanidine forms an excellent accelerator when applied in the form of its more stable bicarbonate salt."

That di-aminoguanidine is an effective accelerator of rubber vulcanization when used in the form of its bi-carbonate salt is stated definitely by defendant's witness, Bridgewater (Vol. I, p. 489-490, Q. 21). He demonstrated its effectiveness by actual trial (Ex. GG, Vol. II, p. 971).

It is no answer whatever to this to say, as plaintiff has said, that Weiss applied for his patent on his method of making DPG (Vol. II, following page 1002) on July 2, 1921, and that the publication of the Du Bosc article occurred less than two years prior to the application for that method patent. This is so because the method patent contains no reference whatever to disubstituted guanidines as a class or to any member of that class other than DPG.

Anticipation of these broad claims by this Du Bosc article is therefore complete, under the authority of *The Incandescent Lamp Patent,* 159 U. S. 465, in which this Court said at page 476:

> "In fact, such a construction of this patent as would exclude competitors from making use of any fibrous or textile material would probably defeat itself, since, if the patent were infringed by the use of *any such material,* it would be anticipated by proof of the prior use of *any such material.*" (Italics ours.)

Second, these three claims are invalid because they are broader than any invention made by Weiss. We have Weiss's admission that, prior to filing his application for the patent in suit, he knew of only two di-substituted guanidines which were accelerators, namely, diphenylguanidine and ditolylguanidine (Vol. I, p. 178, Q. 441). The fact is that there are innumerable other substances which fall within the broad definition of a di-substituted guanidine.

Defendant's witness Bridgewater said he thought there were between 50 and 100 such substances that had been prepared and 500 to 1,000 others which could be prepared if there were any occasion for doing so (Vol. I, p. 486, Q. 12). Of this large number, Weiss says he knew only two were accelerators at the time he filed his application for the patent in suit and yet he undertook to claim the monopoly of a patent for every one of the hundreds of substances about which he knew nothing, though all agree that the only way to ascertain definitely whether or not a substance will act as an accelera-

tor is to try it. Therefore, these three claims are of broader scope than any contribution which Weiss could have made to the accelerator art because they are broader in scope than such knowledge as Weiss possessed at the time he applied for his patent. A duplicate of this situation came before the Court of Appeals for the Second Circuit in *Matheson* vs. *Campbell,* 78 Fed. 910-915, in which the Court said:

> "In other words, having himself experimented only with three or four bodies out of a group of hundreds, he proposes to set himself in the pathway of future experimenters with any or all of the other bodies, and, as the result of each new experiment is disclosed, will fire away at it, calculating to 'hit it if it is a deer and miss it if it is a cow.' * * *
>
> The inventors did not make any such 'broad discovery.' They made the specific discovery that some di-sulpho acids, treated according to their process, would produce their product. * * *
>
> Some future experimenter will have to make some new discovery, and invent some new process, before these other sulpho acids can be transformed into naphthol-black. We are referred to no authority, and know of no principle, which will sustain the complainant's contention that he can thus, in the language of the circuit court, 'speculate on the equivalents of his claimed invention, and thereby oblige the public to resort to experiments in order to determine the scope of the claims of his patent.' "

See also:

Treibacher vs. *Roessler,* 219 Fed. 210, 212, C. C. A., 2nd Cir.;

Bracewell vs. *Passaic Print Works,* 107 Fed. 467, 473;

Rickard vs. *Du Bon,* 97 Fed. 96-99;

Kintner vs. *Atlantic Co.,* 249 Fed. 73-77.

Thirdly, these three broadly worded claims are invalid because there are various di-substituted guanidines which are not accelerators. Among the hundreds of di-substituted

guanidines which have been or can be made, defendant has tried some of them and has demonstrated that they are not accelerators of the vulcanization of rubber. This is stated positively by defendant's witness Bridgewater (Vol. I, p. 486-8, Q. 16-17). His testimony was based on actual tests and records of his tests are in evidence as Exhibit HH. The preparation of the substances referred to is covered by the deposition of defendant's witness Powers (Vol. I, p. 549-557).

The proofs before the Court show beyond question that there are these substances which are di-substituted guanidines (so that they fall within the definition of these claims) and which are not accelerators (so that they will not accomplish the purpose of the patented invention) and that is fatal to the validity of these broad claims.

Weiss undertook to "claim blindly the entire group of compounds" which is what the Court said "will not do" in *Bracewell* vs. *Passaic Print Works, supra.* The situation is similar to that presented in *Matheson* vs. *Campbell, supra,* where the patentee had experimented "with three or four bodies out of a group of hundreds" and did not know whether the others in the group were similarly serviceable; except that in this instance the patentee had experimented with not more than two out of a group of hundreds and now it appears that other members of the group are *not* serviceable for the purpose.

If Weiss had discovered some "general quality" common to all di-substituted guanidines which made all of them effective as accelerators, the situation presented would be different. But we know now that he did not make any such discovery because there are these numerous di-substituted guanidines which are not accelerators at all. Therefore, this defense is identical with that which was sustained by this Court in *The Incandescent Lamp Patent,* 159 U. S. 465, wherein the Court said at page 475:

> "If, as before observed, there were some general quality, running through the whole fibrous and textile kingdom, which distinguished it from every other, and gave

> it a peculiar fitness for the particular purpose, the man who discovered such quality might justly be entitled to a patent; but that is not the case here".

There is no "general quality" or "peculiar fitness" common to all the substances in the class of di-substituted guanidines. That peculiar fitness is possessed by only specific members of the class. For that reason it would be improper to sustain these broad claims whose wording was selected with the object and intent of covering a whole class of substances including innumerable substances of which Weiss knew nothing and various substances which are not accelerators at all. The *Incandescent Lamp Patent* is a precedent as directly applicable to this case as one could be and requires that these broad claims be invalidated. The whole of the announcement of principles in the opinion in that case on page 472 of 159 U. S. applies with equal force here and could be paraphrased with the names and substances involved in this suit.

In Conclusion.

Supplementing the foregoing presentation of specific defenses against the validity of the patent in suit, there are a few matters of general application which should be discussed, chief among them being the commercial exploitation of DPG and the conflicting decisions of the lower Courts.

Commercial Exploitation of DPG.

On the record before the Court, it may properly be said that plaintiff was the first to offer DPG for sale in quantity to rubber manufacturing companies. Also, there is proof of a license under the patent under which royalty has been paid. These two things will doubtless be urged upon the Court's attention. A brief discussion of them by defendant seems, therefore, to be required.

We have heretofore set forth in detail Weiss's work with the Republic Rubber Company in 1918 and the first part of 1919, how the Republic Company was preparing for the manufacture of TPG as an accelerator while nothing whatever was being done with DPG, how in September, 1919, Daniels heard Dr. Kratz's paper at the Philadelphia meeting and returned to the Republic plant with the copy of Kratz's table which he promptly showed to and discussed with Weiss, how beginning immediately thereafter there was feverish activity in the Republic plant in experimentation with DPG, and how on December 1, 1919, Daniels wrote to one of his assistants that he was "through with TPG" and that DPG "is the king pin now" (*ante*, p. 56-58).

Weiss's work with DPG in the late months of 1919, together with Kratz's data, made Weiss know that DPG was an excellent accelerator, and his investigations indicated that the literature contained practically no directions as to how to make DPG in quantity at low cost (Vol. I, p. 102, Q. 46-9). Accordingly, Weiss set himself to the task of devising a process for that purpose (Vol. I, p. 128, Q. 150). At some time in the winter of 1919-1920 he succeeded in devising such a process and by the time he was dismissed from the employ of the Republic Company in March, 1920, he had written out directions for a procedure suitable for producing DPG in quantity (Vol. II, p. 1025, Q. 28, and *National* Rec., p. 239, Q. 166-173). It was then that Weiss applied for employment with one after another of the rubber companies in Akron, including the Firestone Company (Vol. I, p. 128, Q. 153); and meeting with no success, he went to New York and applied first to the National Aniline & Chemical Company (Vol. I, p. 162, Q. 351) and then to Doty and Woodward (Vol. I, p. 129, Q. 156 and p. 163). We know that when applying to the Firestone Company and the National Aniline & Chemical Company he mentioned the Kratz paper as authority for the value of DPG and claimed that he had produced a process for making DPG, but did not intimate that he was concerned in any way with any discovery in con-

nection with DPG other than in manufacturing it (Vol. II, p. 1013-5 and 1023-30).

When Weiss applied to Doty and Woodward in April, 1920, they were and for some years past had been connected with the manufacture of chemicals used by the rubber industry (Vol. I, p. 129, Q. 156) and it was only natural that they should be interested in Weiss's story that he had devised a process for making DPG and that DPG was a better accelerator than those the rubber industry was then using. So Doty and Woodward and Weiss joined forces and after some few months began to manufacture DPG on a small scale and to offer it to the rubber trade. Along in 1921 they had a small plant at which the chemical was being turned out (Vol. I, p. 129-131). By July of 1921 they applied for a patent on Weiss's method of manufacturing DPG (Vol. II, following p. 1002) and also for a patent for some other accelerator (Vol. I, p. 169, Q. 392). Then in November, 1921, the application for the patent in suit was filed, and the patent issued in March, 1922.

In 1921, or before the patent issued in March, 1922, at least three other chemical manufacturing companies had put DPG on the market or were preparing to do so. In each instance these other companies knew of the Kratz paper of September, 1919, with its statement that DPG is far more active than TPG and its figures representing mathematically the degree of superiority. No one of these three companies has recognized the Weiss patent in suit (Vol. II, p. 1018-9, and p. 1009-12). More recently one other manufacturer has become a licensee under the patent in suit, but it should be noted that the license agreement covers a license not only under the patent in suit but also under the other Weiss patent for the method of making DPG and certain patents of foreign countries (Vol. I, p. 267-8, Q. 31-4).

These being the facts, we submit that no inference whatever may properly be drawn from them, and no sound argument may be based upon them, against the sufficiency of the defenses we have presented at length above.

Through the years since 1921, plaintiff and others have gone on selling DPG to the rubber industry and the substance has been used by the industry to such extent that its value as an accelerator is beyond question. It has not superseded all other accelerators and apparently never will, for there is no such thing as a universal accelerator (Vol. I, p. 410, Q. 334-5). Also, there are other accelerators which are more active, some of them very much more active and known as ultra accelerators (Vol. I, p. 417-8, Q. 358-367; p. 421, Q. 384-6). But several desirable qualities are combined in DPG which have led to its use on a substantial scale (Vol. I, p. 506, Q. 33).

But there is no occasion for harping on these facts in this suit. The utility of the patented accelerator has never been questioned, and the success of a plaintiff in its exploitation of a patented device is of consequence in a patent suit only on the question of invention. When the Court has determined, by reference to the patent and to the prior art, what it is that the patentee invented, then if the Court finds itself in doubt as to whether or not that achievement involved the exercise of invention, it is appropriate to consider whether or not the successful exploitation warrants resolving the doubt in favor of the patent. This is in accordance with *Smith* vs. *Goodyear,* 93 U. S. 486, and *McClain* vs. *Ortmayer,* 141 U. S. 419, 428, and numerous other cases.

But this matter of successful exploitation has no bearing on an issue of anticipation. If the patented idea was disclosed in prior patents, or was first invented by another, or was known to others before the patentee's invention, the patent in suit is void and that is the end of it. No amount of commercial success can alter the fact of lack of novelty or prior invention or prior knowledge or prior use. This proposition has even been asserted by this plaintiff when trying to explain why Weiss and Daniels and the Republic Company made no use of DPG; plaintiff has said:

> "The fact that the Company did not use DPG then or later in its commercial products has nothing at all to do with whether or not Weiss had completed his invention".

These considerations alone should suffice to dismiss the matter of successful exploitation from this case.

But there is another and equally strong reason for considering it of no consequence. Such success as this plaintiff has attained in exploiting DPG was due to the invention of a method of making DPG at low cost covered by the other Weiss patent, the one which is not in suit (Vol. II, opposite p. 1002). Up to the time when Weiss devised that method, DPG could be produced only by a time-consuming and expensive method which has been characterized in this case as the laboratory method; that method was outlined in the text-books on chemistry and it is the method used by Weiss in his early experiments and by Dr. Kratz as described in his Norwalk report (Vol. II, p. 954-5-6). That method is so expensive that no substance made at such a cost would be usable as an accelerator in commercial manufacture. This is stated to be the fact in the patent in suit in lines 36 to 44. It is also stated even more definitely in the other Weiss patent as follows (Vol. II, opp. p. 1002):

> "Prior to my invention it has not been possible to produce diphenylguanidine except in small quantities for use in chemical research and laboratory experiments. Even when produced for this purpose the product has been accompanied by the formation of comparatively large quantities of carbodiphenylimide, a thick treacle-like fluid, from which the diphenylguanidine is difficult to separate and which greatly reduces the yield of the latter."

Had the situation continued unchanged in this respect, DPG would never have been used commercially though every chemist in the rubber industry knew of its great activity. But in this situation Weiss devised his patented method of making DPG in the winter of 1919-1920 and it is to his production of that process of making DPG cheaply, and in being the first to devise such a process, that the effort of the plaintiff company to sell DPG to the rubber industry is due. As this plaintiff has heretofore said "Without it his vulcanization discovery was useless." And Woodward said he would

not have gone into the Dovan enterprise but for this process of making DPG cheaply (Vol. I, p. 248, Q. 45).

There is nothing novel in the situation thus presented. A similar situation was presented to this Court in *Lovell Manufacturing Co.* vs. *Cary*, 147 U. S. 623, 635, and the Court, speaking through Mr. Justice Blatchford, said:

> "It is contended, however, by the plaintiff, that the applicability of the former processes is contradicted by the fact that no one had used them for the manufacture of furniture springs, and that as soon as Cary's process was made known, the art of making furniture springs was revolutionized. But, it was said by this Court in McClain *vs.* Ortmayer, 141 U. S. 419-428 (35 L. Ed. 800 and 804):
>
> > 'That the extent to which a patented device has gone into use is an unsafe criterion even of its actual utility, is evident from the fact that the general introduction of manufactured articles is as often effected by extensive and judicious advertising, activity in putting the goods upon the market and large commissions to dealers, as by the intrinsic merit of the articles themselves;'
>
> and that while,
>
> > 'in a doubtful case, the fact that a patented article had gone into general use, is evidence of its utility, it is not conclusive even of that, much less of its patentable novelty.'
>
> In the present case, it appears that it was not until a short time before 1870 that furniture springs began to be commonly made of steel wire. It was not until 1868 when the general introduction of Bessemer steel and open hearth steel afforded a cheap substitute for iron, that the use of steel became general in the art in question. It was then natural that there should be introduced into that art methods of treatment which were well known as applied in allied arts."

See also

Shelby Steel Tube Co. vs. *Standard Seamless Tube Co.*, 286 Fed. 863, 869; C. C. A., 3rd Cir.

Dueber Watch-Case Mfg. Co. vs. *Robbins*, 75 Fed. 17, C. C. A. 6th Cir.

The Court of Appeals of the Second Circuit in the *National* Case illustrated this situation by reference to radium. If some one discovered that radium was an excellent accelerator, it may well be that he would be entitled to a patent for his discovery. But no commercial use of radium in manufacturing rubber would follow. However, if, after that discovery, some one, that same man or some one else, devised a process of extracting radium at a cost of 50 cents per pound instead of $50,000 per gram, then radium might come into quite general use as an accelerator, and certainly the discovery of that process of producing radium would be entitled to patent protection. In other words, there could be no commercial use until both inventions had been made, and in applying the two patents it would be quite essential to hold each of them to the particular invention covered by it, especially as the two inventions might have been made by two different men.

A similar illustration can be drawn directly from this field of accelerators. Dr. Kratz's paper of 1919 announced the high accelerating value of mono-phenylguanidine (MPG). So since 1919 rubber chemists and manufacturers have known that MPG is an excellent accelerator. But MPG has never been used commercially; the reason for this is that no one has as yet devised a process of making MPG at reasonably low cost.

Suppose some one should now invent a process of making MPG cheaply. Doubtless it would come at once into substantial commercial use. Also, the discoverer of that method of making MPG would unquestionably be entitled to a patent covering his process. But it is equally clear that he would not be entitled to a patent covering the use of MPG as an accelerator for the simple reason that the accelerating value of MPG has been a known fact even since Kratz published it in 1919.

It is obvious, therefore, that any credit for the commercial success of DPG as an accelerator cannot properly be ascribed to the alleged invention of the Weiss patent in suit;

and if any part or all of it is to be ascribed to the Weiss patent for his method of making DPG, that is a matter of no consequence in this litigation.

The Conflicting Opinions.

The opinion of the Court of Appeals for the Second Circuit in the *National* case is a clear, crisp, concise and positive statement of the issue presented by the record and the conclusion of the Court thereon. The opinion of the District Court in this *Corona* case, based on practically the same record, is equally definite in the statement of the conclusion reached and the reasons therefor, though the discussion is more extended, particularly in that it comments on, and rules upon, the credibility of the important witnesses.

The opinion of the Court of Appeals for the Third Circuit in this *Corona* case, on the other hand, is of strikingly different character. It is confused throughout, particularly with respect to ascertainment of the issue to be decided. Its outstanding characteristic is failure to grasp one of the fundamentals of this case, namely, that the issue and the only issue of this suit, is the validity of one and only one patent, *i. e.*, the patent which purports to cover the discovery that DPG is an active accelerator. That one patent was grouped and inextricably combined with the other Weiss patent which is *not* in suit, so much so that the greater part of the discussion in the opinion is irrelevant, and ascertaining the Court's views on the defenses presented is impossible. The Court appears to have concluded that Weiss contributed something toward the use of DPG in commercial rubber manufacture; and therefore the Court sustained the patent which happened to be before it without inquiry into the relation of the subject-matter of that patent to the commercial use.

The conclusion that Weiss had contributed something seems to have resulted largely or entirely from finding that Weiss or his company was the first to offer DPG for sale in

quantity to the rubber industry There appears to have been a complete failure to realize that such offering of DPG for sale in quantity could occur only after and as a result of two achievements, each wholly separate and distinct from the other, namely, (1) the discovery that DPG is an active accelerator, and (2) the discovery of a process for making DPG in quantity at low cost. These two are separate and distinct in the mental sense, as conceptions of the brain; and they are separate and distinct in the physical sense since they are investigated and demonstrated in wholly different ways, with wholly different apparatus, and by the application of wholly different principles. Also, they have been recognized as separate and distinct conceptions by the application for and the grant of separate patents in which they are disclosed and claimed.

It seems so elementary as not to require discussion that both of the two discoveries must have been accomplished before there could be any extensive commercial use of DPG in the manufacture of rubber, and yet that obvious fact seems to have escaped the attention of the two members of the Court of Appeals of the Third Circuit who joined in the opinion. The result was that the two Weiss patents were combined and everything that could be credited to Weiss in the art of vulcanization accelerators was treated as a potent item in favor of sustaining whatever Weiss patent happened to be before the Court.

Instances of the confusing and combining of the two Weiss patents though only one of them is in suit may be noted as follows:

The opinion states near the middle of page 1031, Vol. II:

> "* * * no one prior to Weiss seems to have conceived and worked out any practical plan by which DPG's potential powers could be commercially used. The reason for this is plain for no one knew, or, for that matter, had tried to learn, how DPG could be produced in such quantity as to make possible its commercial use".

This has nothing to do with the patent in suit. It relates to the patent which is not in suit, the later Weiss patent. That is the patent which tells

> "* * * how DPG could be produced in such quantity as to make possible its commercial use".

Weiss himself, who claims to have made the invention of the patent in suit in September, 1918, and who claims to have used DPG in the vulcanization of rubber in the winter of 1918-1919, said that the use of DPG commercially was not possible then and did not become possible until much later, when he devised the process disclosed in his later patent which is not in suit (Vol. II, p. 1002, side folio 297, l. 24-34). And Weiss's associate, Woodward, said he would not have gone into the business of exploiting DPG except for the process of the later Weiss patent (Vol. I, p. 248, Q. 45).

Near the top of the next page (1032) of the opinion, it is stated that Weiss

> "* * * turned his attention to discovering some way to make DPG commercially. His efforts in that line resulted in his discovery disclosed and practically utilized in the patent in suit".

This, of course, would find no support in any quarter. Weiss claims to have made the "discovery disclosed * * in the patent in suit" long before he gave any thought to a "way to make DPG commercially". "Discovering some way to make DPG commercially" resulted in the patent which is *not* in suit.

Lower down on the same page (1032) of the opinion, it is stated that if Weiss

> "* * * showed the world in addition how to make this product in commercial quantity in the rubber vulcanizing art, it would seem to us, and we so hold, that a claim, such for example as his eighth" (which is quoted) "was inventive in character and valid".

This statement discloses again what we believe to be the fundamental error of the opinion. "How to make this prod-

uct in commercial quantity" is the invention of the second patent. That patent discloses it and both plaintiff and defendant have so stated innumerable times. But if that achievement were of tremendous magnitude and were a great boon to humanity and the patent for it were a hundred times valid, that would have no bearing on whether or not some other patent is valid. Yet the Court states that because of that achievement of the patent *not* in suit, the patent which *is* in suit is valid.

Again, it is stated in the opinion in the lower part of page 1034, that

> "* * * no one had theretofore disclosed to the art or instructed it how DPG could be practically produced or, of course, practically used".

Again we point out that it is plaintiff's claim that Weiss completed the invention of the patent in suit before he gave any thought to "how DPG could be practically produced".

This same thing which we conceive to be a fundamental error pervades the discussion of the work of Dr. Kratz. The opinion states, in the middle of page 1035, referring to the authors of the Kratz paper:

> "Conceiving they had devised some way to make DPG commercially, did the paper tell the art how it could be done? That the paper did not give such information is clear".

No one has ever contended that the paper gave such information, or that it gave any information whatever about how to make DPG commercially.

The ideas expressed in these extracts from the opinion, and others of like purport, relate to the second Weiss patent, not in suit, covering Weiss's process of making DPG. It was that process which made commercial exploitation possible and which induced Doty and Woodward to attempt exploitation and which was used in initiating the exploitation that actually did take place (Vol. I, p. 248, Q. 44-6). This improper combining of the two distinct patents and the irrele-

vant discussion of the second patent and the unsound reasoning they led to seem to us to have developed from, and to be a not unnatural result of, failure to determine and formulate with particularity the issue to be decided, especially failure to ascertain with the requisite certainty the particular invention before the Court for adjudication.

An excellent instance of the exercise by this Court of meticulous care in ascertaining exactly what the patent in suit covered, and, on finding that it covered a specific substance or article, pointing out that the process by which that article was made was wholly irrelevant, is found in *Cohn* vs. *U. S. Corset Co.*, 93 U. S. 366.

Other outstanding points about the opinion are the following:

To the extent that it is possible to say from the opinion, the Court appears to have concluded that Weiss made the invention of the patent in suit in December, 1918 (Vol. II, p. 1031). In reaching that conclusion the Court appears to have given no consideration to the rule that the trial Court's decision on credibility of the witnesses produced is to be accepted by the appellate court in the absence of manifest error. Along with that, the Court appears to have attached no consequence to the discrepancies and contradictions in the various statements of Weiss, and the misrepresentations by, and the direct conflict between, Weiss and Daniels, which should have led to refusal to accept their testimony irrespective of the trial Court's conclusion. Also, in crediting Weiss with completion of the invention in December, 1918, no weight appears to have been given to the direct statement by Daniels, who was Weiss's immediate superior and to whom Weiss reported, that as late as the summer of 1919 he "wasn't prepared to say how good" DPG was (Vol. I, p. 222, Q. 135).

All of the proofs about the work of Dr. Kratz prior to reading his paper in September, 1919, were also passed over as not deserving mention. The defenses of prior knowledge, prior invention and prior use which had been sustained by the Court of Appeals in the *National* case, received no word of

comment; on what ground any one of those defenses was thought to be insufficient lies wholly in conjecture.

The Kratz paper is discussed in the opinion only to belittle it, though one of the witnesses for *plaintiff* characterized it as the most interesting paper on accelerators he had heard and the one which gave the most definite information (Vol. I, p. 216, Q. 92-5). It was so interesting and informative that those present when it was first read took notes (Vol. I, p. 212-3, Q. 71-5; p. 651, Q. 11-19; and Vol. II, p. 1023-4, Q. 4-9). The notes which Daniels took he immediately called to the attention of Weiss (Vol. I, p. 155-7, Q. 314-8; p. 217-9, Q. 102-111), and the effect was almost electric; immediately there was great activity in tests with DPG, entries of those tests appear in the X-book in great number, the long-continued development of TPG ceased abruptly, and the chief chemist of the plant wrote that he was through with TPG and that "diphenyl is the king pin now." And a few months later we find Weiss citing the Kratz paper as authority (Vol. II, p. 824) for the value of DPG as an accelerator, though the paper had not yet appeared in print. This last item, Weiss's application for employment at Firestone (*ante*, p. 22-24), is justly entitled to controlling importance in this suit and it receives no mention in the opinion of the Court of Appeals. There, in Weiss's own handwriting, made long before any controversy arose and before the thought of a patent was entertained, is Weiss's own tribute to the Kratz paper. It is the authority which Weiss himself, of his own volition, chose, to gain acceptance for his proposition that DPG is an active accelerator and that a rubber manufacturer would do well to make it by the process which Weiss claimed to have devised.

Finally, the opinion refers time and again to the presumption to be drawn from the action of the Patent Office in granting the patent, and yet the Court does not accept or concur in the views of the Patent Office which led to the grant of the patent. The Court held the Kratz paper insufficient as a disclosure of the invention of the Weiss patent, whereas the Patent Office held it to be a complete disclosure. The Patent

Office granted the Weiss patent only because it had no information as to what was done by Kratz prior to reading his paper, but all of the facts about Kratz's prior work were before the Court.

We note these points, which we think of as deficiencies in the opinion of the Court of Appeals, by way of contrasting the opinion with that of the Second Circuit Court of Appeals in the *National* case wherein there is a clear and exact statement of the issue to be decided, instead of confused intermingling of two unrelated achievements, and definite rulings on the defenses presented, instead of passing over those defenses without mention while magnifying matters of no consequence like the Kratz cross-examination and the Williams report. We have commented on the Kratz cross-examination above (*ante* p. 84-7). As to the Williams report, it characterizes the Kratz paper as "or particular interest" (Vol. II, p. 775), and what the report characterizes as "unimportant" (Vol. II, p. 776) is the "symposium * * * which followed" the reading of several papers, though it is evident that the Court erroneously considered this latter comment to apply to the Kratz paper.

The opinion of Circuit Judge Manton in the District Court in the *National* case is quite similar to that of the Court of Appeals in this case. For instance, Judge Manton said:

> "The Weiss tests recorded in the spring of 1919, were before the reading of the Kratz paper, and demonstrate that Weiss had been working on the production of diphenylguanidine in commercial quantities".

They demonstrated no such thing and no one ever contended that they did. No one representing *plaintiff* has ever asserted that Weiss began work on "the production of diphenylguanidine in commercial quantities" until long after these tests in the spring of 1919. Here again, items which if true would be tributes to the second Weiss patent, not in suit, are assigned as grounds for sustaining the first Weiss patent which in in suit.

As to Kratz's work, Judge Manton held that Kratz made the tubes at the Falls Rubber Company as alleged by defendant, but that the amount of DPG in them was too small to have a substantial curing effect, a proposition which not only was not sustained by the proofs in the *National* case, but has not even been advanced by plaintiff in this case.

Dr. Kratz's work at Norwalk at the end of 1916 was held to have been an abandoned experiment, though the Court specifically held that Kratz used DPG in making the tubes at the Falls plant in the following year, and, of course, publication followed a short time later.

Criticism of and answer to these opinions could be extended indefinitely. If we have given the Court an adequate exposition of the facts of this case, as we trust we have, the fallacies of the opinions will be apparent.

It is clear that the patented invention was *known* prior to the earliest date claimed for Weiss. Therefore, there is no sound theory on which the Weiss patent can be sustained and which conforms to the decisions of this Court in *Coffin* vs. *Ogden*, 18 Wall. 120, and the recent case of *Alexander Milburn Co.* vs. *Davis-Bournonville Co.*, 270 U. S. 390. In *Coffin* vs. *Ogden*, the alleged prior invention and prior knowledge were testified to by the prior inventor and by three other persons, and this Court, in declaring the patent in suit invalid, said:

> "The prior knowledge and use by a single person is sufficient. The number is immaterial."

In the *Milburn* case, this Court said:

> "Clifford had done all he could do to make his description public",

and all Clifford had done was to include a description in an application filed by him in the Patent Office on which no patent had yet issued. Here Kratz told his superior officer

about the invention and wrote out a description in the official record of his company and made a full disclosure orally and then in print, all before Weiss took the first step toward publication. This Court said:

> "The fundamental rule we repeat is that the patentee must be the first inventor",

and that rule we invoke here. This Court said further that it is not necessary to prove who was the first inventor but only that the patentee was not. Here defendant has gone further than was held to be necessary; it has proven who was the first inventor, and has shown an amount of prior knowledge substantially greater than was held to be sufficient in the *Milburn* case. And whereas in the *Milburn* case the proven prior knowledge found to be sufficient did not ripen into publication before the patent in suit was applied for, here there was wide publication more than two years before the application for the patent in suit was filed.

We submit, therefore, that the conclusions of the Court of Appeals of the Second Circuit in the *National* case should be adopted by this Court.

Respectfully submitted,

DEAN S. EDMONDS,
WILLIAM H. DAVIS,
FRANK E. BARROWS,
Counsel for Petitioner.

New York, N. Y., December 15, 1927.

CHRONOLOGY OF THE WORK OF KRATZ AND WEISS

KRATZ	WEISS
1916	
Kratz's Norwalk Tests. About 100 tests of eight different accelerators in rubber compounds, including 9 to 12 tests with DPG, resulting in a table of relative accelerating values (Vol. II, p. 838). Kratz fully corroborated by Russell and by written records.	
1917	
Kratz's Tubes made at Falls Co. in August and September. About 300 inner tubes made using DPG as accelerator and sold in the regular course of business.	
1918	
Kratz conducted a further series of tests at the Falls Co. with the same eight accelerators previously tested at Norwalk and obtained the table of relative accelerating values which appeared later in the Kratz paper.	Weiss alleged conception in February or March. No written record made. Three tests claimed to have been made by Weiss using DPG in December, all overcured. These tests were not recorded in the X-book; there is no record of them, and Weiss's affidavit says the amount of DPG he succeeded in making was insufficient for a test.
1919	
	Two or three tests using DPG made by Weiss in February and March. The date of one test has been altered in the X-book. The other two tests are on shoddy mixtures and showed no superiority of DPG over TPG. Between March 4 and September 10 no further tests using DPG were recorded in the X-book and Weiss's uncorroborated statement that some were made is inconsistent with his former testimony. Daniels, the Chief Chemist of the Republic Co. and Weiss's superior, said he was not prepared to say how good DPG was, and TPG was the accelerator being actively developed at Republic.

UNITED STATES PATENT OFFICE.

MORRIS L. WEISS, OF BROOKLYN, NEW YORK, ASSIGNOR TO DOVAN CHEMICAL CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

VULCANIZATION ACCELERATOR.

1,411,231. Specification of Letters Patent. Patented Mar. 28, 1922.

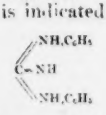
No Drawing. Application filed November 12, 1921. Serial No. 514,727.

To all whom it may concern:

Be it known that I, MORRIS L. WEISS, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Vulcanization Accelerators, of which the following is a full, clear, concise, and exact description.

The object of my invention is to improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose. It is known that when certain organic substances are added to the rubber mix during the compounding, a catalytic or similar action is produced which causes the rubber or similar gum to unite or react more rapidly and thoroughly with sulphur or other vulcanizing agents.

I have discovered that disubstituted guanidines particularly diphenylguanidine is particularly effective for this purpose. This substance is indicated by the formula



I am aware that disubstituted guanidines have been produced by laboratory methods and have been known to chemists for many years beginning about the year 1848 with the work of A. W. Hoffman (An. Chem. Pharm. 67–129), but down to time of my researches in accelerators of this type, it was apparently not known that di-substituted guanidines were efficacious or useful as accelerators in vulcanizing, nor that this substance could be produced in sufficiently large quantities in a substantially pure form, or at a sufficiently low cost to be available for this purpose.

I am aware that triphenylguanidine has been suggested, and probably used to some extent, as an accelerator in the vulcanization of rubber, but the use of diphenylguanidine for that purpose appears to have been unknown prior to my researches on this substance.

I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but results in a final product much superior in texture, strength, durability and aging qualities over that when the triphenylguanidine is used. A greatly improved product also results when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards elasticity, aging qualities and freedom from "bloom." In these and similar instances, it has been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressures than those commonly employed.

In my prior application Serial No. 482,143 filed July 2, 1921, I have described and claimed a process for producing and purifying diphenylguanidine in commercial quantities, and have therein given a résumé of the historical development of the methods of producing the same.

As set forth in said application, I, at present, prefer to produce my improved accelerator by desulphurizing thiocarbanilide by the action of a metallic oxide, such as lead oxide, zinc oxide, etc., in an alcoholic solution of an ammonium salt, such as ammonium nitrate.

The present patent application therefore relates to the vulcanization of rubber or similar substances, in which disubstituted guanidines are employed as the accelerating agent or catalyzer, and particularly diphenylguanidine.

The method of carrying out my invention, which I at present deem preferable, may be illustrated by the following example:

The rubber may be compounded in the following proportions: 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, 1 part by weight of diphenylguanidine.

These are mixed together in any suitable way, such as by milling, and then vulcanized or cured in the usual molds or otherwise under heat corresponding to a steam pressure of about 40 lbs. per square inch. This vulcanizing temperature should be continued until the compound is suitably vulcanized, which requires from 10 to 20

minutes depending upon the shape and size of the articles being vulcanized.

It will therefore be appreciated that when using the accelerator according to my invention the vulcanization is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness without danger of over-curing the softer or more elastic parts. I have found moreover that diphenylguanidine does not need zinc oxide to shorten the time of cure. I however prefer to use zinc oxide on account of its effects on the physical properties of the product.

Having thus described this example of my invention and the method of using the same, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, etc., indicated, for various changes may be made without departing from the essential features of my invention as set forth in the accompanying claims.

What I claim and desire to protect by Letters Patent is:

1. The process of treating rubber or similar materials, which comprises combining with the rubber compound a di-substituted guanidine.

2. The process of treating rubber or similar materials which comprises combining with rubber compound a di-substituted guanidine comprising two phenyl radicles or groups.

3. The process of treating rubber or similar materials which comprises combining with the rubber compound an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

4. The process of treating rubber or similar materials which comprises combining with the rubber compound diphenylguanidine.

5. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine accelerator.

6. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine comprising two phenyl radicles or groups.

7. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

8. The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine.

9. A vulcanizing compound of rubber or similar material combined with a vulcanizing agent and a di-substituted guanidine.

10. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and di-substituted guanidine comprising two phenyl radicles or groups.

11. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine.

Signed at New York, N. Y., November 10th, 1921.

MORRIS L. WEISS.

UNITED STATES PATENT OFFICE.

MORRIS L. WEISS, OF BROOKLYN, NEW YORK, ASSIGNOR TO DOVAN CHEMICAL CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

PROCESS OF MAKING DIPHENYLGUANIDINE.

1,422,506. Specification of Letters Patent. Patented July 11, 1922.

No Drawing. Application filed July 2, 1921. Serial No. 482,143.

To all whom it may concern:

Be it known that I, MORRIS L. WEISS, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Processes of Making Diphenylguanidine, of which the following is a full, clear, concise, and exact description.

Diphenylguanidine is indicated by the formula

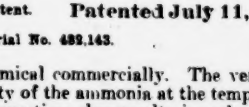
The object of my invention is the production of this substance in large or commercial quantities so that the same may be available in the chemical industries and particularly as an accelerator in the vulcanization of rubber compounds, as set forth in my co-pending application Serial No. 514,727, filed November 12, 1921, for vulcanization accelerators.

Prior to my invention it has not been possible to produce diphenylguanidine except in small quantities for use in chemical research and laboratory experiments. Even when produced for this purpose the product has been accompanied by the formation of comparatively large quantities of carbodiphenylimide, a thick treacle-like fluid, from which the diphenylguanidine is difficult to separate and which greatly reduces the yield of the latter.

Substituted guanidine was probably first synthetically produced in 1848 by A. W. Hoffman (Am. Chem.-Parm 67,—129). Dry cyanogen chloride gas was passed into anhydrous aniline, from which he obtained the hydrochloride of a base which he termed "melaniline," at that time.

In 1869, Hoffman (Ber. 11,—466) synthesized diphenylguanidine by an entirely different method from that previously used. Thiocarbanilide was desulphurized with lead oxide in a solution of alcoholic ammonia. The resulting product had the same properties as that of his first product except that its melting point was 147° C. instead of 120°–130° C.

By Hoffman's last method, a large quantity of polymerized carbodiphenylimide is produced, due to the volatility of the ammonia, and so reduces the yield of diphenylguanidine that it is not possible to produce the chemical commercially. The very high volatility of the ammonia at the temperature of the reaction also results in a large loss. Schall has shown (Ber. 27,—2696) that carbodiphenylimide has a tendency to polymerize into three different isomeric forms. This may be accomplished by either digesting by itself or with acids, or on standing for several hours:



Carbodiphenylimide being very unstable, changes into isomeric forms before the combination with ammonia takes place. The longer the combination is delayed the more of the isomers are produced. The isomers do not combine with ammonia to form diphenylguanidine.

Weith (Ber. VII. 10—16) who first produced carbodiphenylimide or desulphurized diphenylthiourea

has shown that it combines with ammonia probably to form diphenylguanidine and that it is polymerized to form carbodiphenylimide. It also combines with water to form diphenylurea. By taking advantage of these suggestions and using an alcohol-water solution and by substituting an ammonium salt such as ammonium nitrate, sulphate, or chloride, which are not volatile at the reaction temperature 65°–70° C., I am enabled to minimize to a large extent the production of polymerized carbodiphenylimide, which otherwise forms due to the volatility of the ammonia, and thereby obtain a larger yield of diphenylguanidine.

I also found that the percentage of concentration of the alcohol and water solvent had an important effect on the reaction.

One form of the process, which I at present deem preferable, may therefore be described as follows:

Thiocarbanilide is first produced by any suitable method but I prefer to mix 65 parts by weight of carbon bisulphide with 1 part of sulphur, and 120 parts of aniline is then added. The mixture is then brought to a temperature of about 35°–40° C. and kept at

that temperature for several hours after which it is allowed to cool. The semi-solid mass resulting is then spread out to allow an evaporation of the excess of carbon bisulphide and to dry the thiocarbanilide.

The solvent is then prepared by heating about 60 gallons of alcohol having a specific gravity of from .850 to .900 in a suitable kettle or tank and then adding 50 lbs. of ammonium nitrate and the thiocarbanilide above mentioned. The tank is closed by a cover and the temperature of the mixture is gradually raised to about 50° C. and stirred continuously by a mechanically operated stirring device. When said temperature is reached 200 lbs. of litharge are then added and the stirring continued for about one hour, during which time the temperature is gradually raised to about 75° C. At this point a test quantity is withdrawn and tested for thiocarbanilide and if not positive a few pounds more of litharge are added and the stirring continued for a short time or until the desulphurization is complete. The contents of the tank is then allowed to settle, the alcohol drawn off and removed from the lead sulphide by a suitable filter press or other means. The alcoholic solution is then distilled to a specific gravity of .950 and then mixed while hot with about 125 gallons of water and the solution boiled for about one hour. This causes all of the diphenylguanidine nitrate to dissolve, leaving the heavy treacle-like mass of polymerized carbodiphenylimide undissolved excepting a small portion of the latter which goes into solution and which may be removed by adding one or two pounds of "filter-cel," which is diatomaceous earth in the form of a powder used for the purpose of filtering. The solution is then syphoned off and allowed to cool, after which a 25% solution of caustic soda is added, while stirring vigorously until the precipitation is complete. When completely settled the supernatant liquid is drawn off, the diphenylguanidine is filtered out, washed with water and dried.

I have discovered that the diphenylguanidine thus obtained may be further purified for use in particular processes by dissolving and recrystallizing in toluol. The difference in the degree of solubility of diphenylguanidine in hot toluol over that when cold is very marked. It has been found that toluol at its boiling point will dissolve to form a 50% solution of this substance while cold toluol will dissolve only to about 2 per cent.

I therefore dissolve the diphenylguanidine in the portion of about 2½ lbs. of the latter to a gallon of toluol which is thus raised to a temperature of about 105° C. in a closed container. The hot solution is then filtered and allowed to cool, settle and to stand until crystallization is complete.

The crystals are then filtered out and washed several times with fresh or pure toluol to remove the remaining traces of the impurities. About 70 lbs. of pure diphenylguanidine is thus obtained.

Having described this example of the invention, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, and steps set forth, for various changes may be made without departing from the essential features of my invention. For example, other solvents than alcohol may be used, such as wood alcohol, pyridine, etc., and other ammonium salts may be employed instead of ammonium nitrate above mentioned.

What I claim and desire to protect by Letters Patent is:

1. The process of making diphenylguanidine which comprises, desulphurizing thiocarbanilide by the use of a metallic oxide in an alcoholic solution of an ammonium salt.

2. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of a lead oxide in an alcoholic solution of an ammonium salt.

3. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of a lead oxide in an alcoholic solution of ammonium nitrate.

4. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of litharge in an alcoholic solution of ammonium nitrate.

5. The process of making diphenylguanidine which comprises dissolving an ammonium salt and thiocarbanilide in an alcoholic solution, then adding a lead oxide and heating to 75° C. to desulphurize the thiocarbanilide, then dissolving the diphenylguanidine nitrate thus formed, then separating the remaining carbodiphenylimide from said solution by causing precipitation with an alkaline solution, and then washing and drying the precipitate.

6. The process of making diphenylguanidine which comprises dissolving ammonium nitrate in an alcoholic solution, then adding litharge and heating to 75° C. to desulphurize the thiocarbanilide, then dissolving the diphenylguanidine nitrate thus formed, by distillation to a specific gravity of .950 and by addition of hot water, and then separating the carbodiphenylimide from said solution by causing precipitation by the addition of caustic soda, and then washing and drying the precipitate.

7. In a process of making diphenylguanidine the steps which comprise adding an alkali to a solution thereof containing carbodiphenylimide to cause precipitation, and then washing and drying the precipitate.

8. In a process of making diphenylguanidine the steps which comprise adding caus-

tic soda to a solution thereof containing carbodiphenylimide to cause precipitation, and then washing and drying the precipitate.

9. In a process of making diphenylguanidine containing as a reaction impurity carbodiphenylimide, the steps which comprise dissolving the same in hot toluol, cooling and then washing the crystals thus formed.

10. In a process of making diphenylguanidine containing as a reaction impurity carbodiphenylimide, the steps which comprise dissolving the same in hot toluol, cooling, and then washing the crystals thus formed with pure toluol, and then drying.

Signed June 28th, 1921.

MORRIS L. WEISS.

Office Supreme Court, U.
FILED
MAR 11 1927
WM. R. STARSE
CL

IN THE

Supreme Court of the United States.

OCTOBER TERM, A. D. 1926.

No. [redacted] 182

CORONA CORD TIRE COMPANY,

Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,

Respondent.

BRIEF FOR RESPONDENT IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

JOHN W. DAVIS,
JAMES J. KENNEDY,
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IN THE

Supreme Court of the United States,

OCTOBER TERM A. D. 1926.

CORONA CORD TIRE COMPANY,
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vs.

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Respondent.

BRIEF FOR RESPONDENT IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

TO THE HONORABLE, THE CHIEF JUSTICE AND ASSOCIATE JUSTICES OF THE SUPREME COURT OF THE UNITED STATES:

On behalf of respondent, it is respectfully urged in opposition to the petition for writ of certiorari, that although the Circuit Court of Appeals for the 2nd Circuit held the Weiss patent in suit # 1,411,231 invalid, and the Circuit Court of Appeals for the 3rd Circuit in this case held it valid, the decisions are not as irreconcilable as petitioner alleges.

Statement of the Case.

To the extent that the validity of the patent was in issue in both cases, the issues are the same.

The evidence in the two suits is not "practically identical", as stated in petitioner's petition (page 1) and brief (page 1), but, on the contrary, materially different.

No important public or private interests are involved, as indicated in petitioner's petition (page 1) and brief (page 1).

Kratz paper read September 2-6.

The paper was of intense interest to the assembled rubber chemists. Portions of it, including the table of relative accelerating values, were copied by many of those present. Daniels said he had never heard a paper on accelerators that was so interesting or so informative and Shepard said it enabled rubber chemists to apply the accelerators sensibly.

Weiss learned of Kratz's paper from Daniels. Daniels gave Weiss a copy of the table of relative activities of the Kratz paper and instructed Weiss to work with DPG.

All work on TPG at Republic stopped abruptly after the Kratz paper and active work with DPG began.

Numerous tests made by Weiss using DPG during October, November and December.

1920

Kratz's paper published April 1st.

Weiss endeavored to obtain employment by claiming he had discovered a method of making DPG and he cited the Kratz paper as showing the value of DPG as an accelerator.

1921

Weiss's application filed November 12th.

4 yrs., 2 mos. after sale of Kratz Tubes.

3 yrs., 8 mos. after Weiss alleged conception.

2 yrs., 8 mos. after Weiss alleged reduction to practice.

2 yrs., 2 mos. after Kratz's paper and after Weiss learned of Kratz's paper.

1922

On the contrary, the only interest involved here is the private interest of petitioner.

National Aniline & Chemical Co., Inc. being a large chemical manufacturer not in the rubber business, was sued as a *contributory* infringer.

CORONA CORD TIRE COMPANY, petitioner, which is a tire manufacturer, was sued here as a *direct* infringer for using the process of the patent in suit, and producing and selling the product thereof, irrespective of where or from whom it obtained the materials used. Its interest is the only one to be considered here.

I.

Records in the two suits substantially different.

While we think the Court on the *National* record was wrong in holding the patent invalid, the record in the instant case is far more complete as to the failure of Kratz to make any invention or advance the art in any way by either his laboratory work, his lectures, or his writings.

It is shown in both records that what Kratz lectured about in September, 1919, and published in April, 1920,* is substantially what he had found out, *but not published or used*, at Norwalk in 1916, the tables differing only in the factor used for multiplication. In the table worked out by him at Norwalk in 1916 he gave the same relative values as in his lecture of 1919 and publication of 1920. In both cases Kratz was trying to evaluate different accelerators in terms of one another, to secure *the same result*, using aniline as 1 in the 1919 lecture and 1920 paper and as 3 in the 1916 Norwalk work. In the *National* case, the Court erroneously assumed these

* The statement as to this in Brief for Petitioner (page 7), namely, "The critical date, that of the publication, was September, 1919", is incorrect. The date of the publication, within the meaning of R. S. 4886, that is, as a *printed* publication, was April, 1920.

yardstick tables to be not only accurate but absolutely reliable.

In the instant case, respondent's expert witness Williams showed (R. 654) that the tables *could not be duplicated* and (R. 672) that following the Kratz table of equivalents of accelerators *would lead to absurd results.*

This same witness also testified in the instant case that he had heard the Kratz lecture of September, 1919, and produced his original report of that lecture showing that he had gotten nothing out of it.

In both cases, it was shown that respondent, operating under the Weiss disclosures of the patent in suit, first successfully marketed the invention and that others only entered the field in competition after respondent had shown the way and had opened up a large new field of accelerators.

In the instant case, for the first time, is the admission by Kratz, quoted in the decision of the Circuit Court of Appeals, that in giving the lecture he had not intended to give "any information which any other company or competitor could transpose directly for practical purposes".

The defense of public use by reason of Kratz having made tubes in 1917 with DPG was accepted in the *National* case, even though the Court found it "uncorroborated". This holding in the *National* case was in defiance of the rule of this Court enunciated in many cases to the effect that oral testimony of anticipation of a patent is insufficient (Barbed Wire cases, Expanded Metal cases, Loom Co. *v.* Higgins).

In the *National* case no employees of Falls Rubber Company other than Kratz were produced. In the instant case, other employees were produced by respondent, whose testimony was not contradicted in any way by petitioner.

In the *National* case, Kratz testified that *he made the tubes himself* and present counsel for respondent repeatedly so asserted in both brief and argument. The 2nd Circuit Court of Appeals in the *National* case erroneously believed that Kratz did make the tubes himself.

In the instant case, Kratz expressly admitted that *he did not make the tubes.* He further admitted that he did

not himself make up the batches of rubber compound from which the tubes were made. All he now says he did was to personally sift a white powder, which he says was DPG, into a batch or batches of rubber while being milled and that "not a soul" (R. 372, x-Q. 152) knew what the white powder was.

In the instant case, respondent called Shaw who testified, without contradiction on the part of petitioner, that he had been the regular compounder for making up rubber batches for tubes at Falls Rubber Company in 1917 and had no record or recollection of having made up a special batch for Kratz, nor had he ever heard Kratz mention DPG. Also, respondent called a mill man (Hoffman) formerly employed by Falls Rubber Company during the same period who had no recollection of ever having seen Kratz put anything into the batches on the mills.

Kratz, in order to further strengthen his story, stated in the instant case that he marked or told somebody to mark the DPG batches with red tags, but nobody else in the Falls plant ever saw such tags.

In the instant case, it was shown that in the course of manufacturing tubes, starting with compounding the batch, milling, calendering, wrapping the sheet stock on mandrels and curing, stripping and splicing, and marking and boxing, someone else than Kratz in the plant must inevitably have known of such special DPG red tagged tubes being made and sold, if they ever had been.

In the face of all this new evidence, the statement in petitioner's brief (page 6) that the Kratz testimony "is corroborated by related facts and by documents, the latter including a formula written by the witness in the laboratory note book kept by him in the regular course of his work", is incorrect.

The formula does not corroborate Kratz, because as written in ink it does not mention DPG or diphenylguanidine and only contains in pencil the mystic notation "M. or Diphig". There is only Kratz' uncorroborated word as to when he wrote this. The witness Shaw produced, in the

instant case, the T8 formula which is the one Kratz says was used for the tubes. The T8 formula produced by Shaw does not agree with the one given by Kratz in his private laboratory note book. Shaw did not testify in the *National* case.

In short, the record in the instant case as to Kratz is very materially different from the record in the *National* case by reason of damaging admissions by Kratz which he suppressed in the *National* case, and testimony and exhibits here produced for the first time by Williams, Shaw and Hoffman.

In another respect, the record here is different from that in the *National* case, and that is in the testimony by Weiss and his corroborating witnesses Nellen, Carlton and Daniels as to Weiss' activities in making DPG and in curing rubber before the Kratz lecture. The 3rd Circuit Court of Appeals accepted the X-book records of Weiss' first experiments as they appear, and found that Weiss had successfully reduced the invention to practice prior to the Kratz lecture, had then continued his efforts to produce DPG in commercial quantity, and had not abandoned his invention.

Some of the substantial evidence in this record and not in the *National* record is the following:

> Unworkability of Kratz' table as given in the lecture in September 1919 and publication of April, 1920,—shown by Williams.
>
> Contemporaneous record by Williams of the Kratz lecture, showing that the entire effort was to give out as little information as possible and find out as much as possible.
>
> Admission by Kratz that he did not intend to give information which competitors could transpose for practical purposes.
>
> Contradiction by Shaw and Hoffman of Kratz' alleged 1917 manufacture and sale of inner tubes.
>
> Admission by Kratz that "not a soul" knew what he was mixing into the batch of rubber compound on the mill.

No proof that the DPG batches were specially marked with red tags.

Giving by Nellen to Weiss of the MYE formula Exhibit 5 (Exhibits, p. 4) *before* the Kratz lecture, for the purpose of enabling Weiss to test DPG therein.

Additional corroboration by Daniels, Nellen and Carlton of Weiss' work on DPG and its manufacture in the spring and summer of 1919, *before* the Kratz lecture.

In the instant case, the Court, upon the whole record of Weiss' work, rightly as we submit, refused to hold his work prior to the lecture to have been "guided by no principle", as was held by the Court in the *National* case.

II.

No important public or private interests involved.

Petitioner states that by reason of these decisions a state of uncertainty and confusion now exists in the rubber manufacturing industry and in the chemical manufacturing industry which will adversely affect these industries to a substantial extent unless this Court shall take cognizance of this suit.

Petitioner also says that for it or other rubber manufacturers to use some other accelerator would be difficult, expensive, time-consuming and hazardous.

There is no evidence in the record or elsewhere that either the rubber or chemical manufacturing industries are at all concerned over this case. No other rubber manufacturer asked to intervene or be heard, nor did any chemical manufacturer. One large chemical manufacturer, Messrs. E. I. DuPont de Nemours & Company furnished several witnesses and considerable expert testimony for petitioner, but it refused to appear. Counsel for petitioner (R. 270-276) succeeded in having the offer of counsel for respondent, to prove

this concern the real defendant, overruled by the Court. We still believe this concern to be the real defendant, but do not see why this Court should go out of the way to protect such interests as it may have when it refused the opportunity to appear voluntarily. There is not the slightest evidence in the record that any chemical manufacturer, or rubber manufacturer other than petitioner, has any interest in this suit.

The record contains references to numerous other and non-infringing accelerators which are said by petitioner to be just as good as those covered by the patent and to be in substantial use. Petitioner went to considerable effort to prove that tri-phenyl-guanidine (T. P. G.), which is outside of the patent in suit, is as good as, if not better than, the accelerator of the patent in suit.

Since the patent in suit issued in March, 1922, a very large number of new and non-infringing accelerators have been developed and have gone into large consumption by the rubber industry in competition with that of respondent. Competition from these other and non-infringing accelerators is such as to absolutely compel respondent to sell accelerators at a price competitive therewith irrespective of the outcome of this or any other litigation.

The adverse outcome to petitioner of this case renders it liable for accounting, but petitioner is not a chemical manufacturer and its liability in profits, damages, and costs is relatively small.

A large percentage of the chemical industry and a larger percentage of the rubber industry have at all times acquiesced in the patent in suit, while others who have not heretofore acquiesced have expressed a willingness to acquiesce in the decision of the 3rd Circuit Court of Appeals. Hence, if the petition be denied, it is believed that the litigation on the Weiss patent would end without disturbance or excessive cost to either the chemical or the rubber industry.

Conclusion.

It is respectfully submitted that no case is presented for the grant of the writ of certiorari prayed for here and that the petition for such writ should, therefore, be denied.

JOHN W. DAVIS,
JAMES J. KENNEDY,
Counsel for Respondent.

Dated March 14, 1927.

Office Supreme Court, U. S.
FILED
JAN 10 1928
CHARLES ELMORE CROPLEY
CLERK

Supreme Court of the United States,

OCTOBER TERM, 1927.

No. 182.

CORONA CORD TIRE COMPANY,
Petitioner,

vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

BRIEF FOR RESPONDENT.

JOHN W. DAVIS,
JAMES J. KENNEDY,
Counsel for the Respondent.

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Supreme Court of the United States,

OCTOBER TERM, 1927.

CORONA CORD TIRE COMPANY,
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vs.

DOVAN CHEMICAL CORPORATION,
Respondent.

No. 182.

BRIEF FOR RESPONDENT.

THE FACTS.

ADDITIONS AND CORRECTIONS TO PETITIONER'S DISCUSSION OF ACCELERATORS AND THE VULCANIZATION ART.

That portion of the petitioner's brief which deals with the general subject of the vulcanization of rubber and the use of accelerators may be accepted so far as it goes, yet, because of its incompleteness the impression it has contrived to create is entirely misleading. What the respondent desires to add is absolutely essential to a proper understanding of the issues of this case, particularly the nature of the Weiss patent, the degree of invention it involved, and the question of its anticipation.

Vulcanization is the chemical union of raw rubber with sulphur to produce the substance that is the base of practically all commercial rubber products. The primary object of vulcanization is to fix the qualities characteristic of rubber so that the vulcanized product will withstand the wear and tear

of practical use and so that it will not be affected by ordinary variations in temperature. Raw, unvulcanized rubber is unable to stand flexing, abrasion, etc. and tends to become brittle with reductions in temperature and fluid with increases.

In theory, an accelerator is a substance which merely increases the rapidity with which this chemical union between the sulphur and raw rubber takes place. Such acceleration is desirable to save time in the process of vulcanization which is lengthy at best, and to save heat, which is utilized to promote the process even when accelerators are also used; but it is desirable chiefly, to avoid subjecting the rubber to prolonged or intense heating, for heat has a deteriorating effect upon rubber (R., p. 96).

The petitioner's brief truly states that the shorter the period of cure, the better the physical qualities of the resultant product, *other things remaining equal.* (Italics our own). Petitioner then draws the conclusion that, *within some limits,* the speedier the accelerator, the better the product. (Italics again our own.) The discussion that follows develops at considerable length this relation between the speed of the accelerator and the physical qualities of the product; but the limitations on the relation are not similarly developed. As a result the impression is created that speed is the only quality sought in a *commercially usable* accelerator. This is utterly untrue, for *in practice the other things petitioner mentions never are equal.*

Even if the accelerative substance could be introduced into the rubber mixture and had no effect upon it other than the mere promoting of the chemical union of the sulphur and raw rubber, and even if, upon the completion of the vulcanization process the accelerator could be removed from the rubber mixture, there still would be qualities requisite in a commercially usable accelerator other than mere speed.

In almost all kinds of rubber manufacture, the rubber mixture has to be handled for a very considerable length of time

after the introduction of the accelerator before the curing proper begins. It has to be rolled out into sheets, or forced into molds, or spread over models, or any one of hundreds of other manufacturing operations have to be carried out. It is essential that during these manufacturing operations vulcanization shall not begin. Yet the rolling and molding and other manufacturing operations have to be conducted at a high temperature—sometimes as high as 200° F. This is so because these operations can be carried on only if the "mix" is plastic. Because of this, it is necessary that with a *commercially usable* accelerator vulcanization shall not begin until a temperature is reached above that at which the manufacturing operations have to be conducted (R., pp. 43-44). There is a wide variation with different accelerators in the temperature at which vulcanization begins. With many, otherwise desirable accelerators, vulcanization begins at so low a temperature as to make impossible the necessary manufacturing operations; and such substances, though accelerators *in the strict chemical sense* of the term, are obviously *not commercially* usable.

The study of accelerators has also shown that with some, as soon as the vulcanization process is complete, overcure begins at once to develop and the utmost care is therefore necessary to stop the curing process as soon as the optimum cure is attained. With others, only an excessive increase in temperature or an excessive prolongation of the curing process results in overcure (R., pp. 40-41). For factory use, accelerators of the latter class are obviously desirable; they are more nearly fool-proof.

There are, however, few accelerative substances which, when introduced into a rubber mixture, have only the effect, first described, of speeding the union of the sulphur and raw rubber. In most cases chemical reactions take place during the curing process between the accelerator and the rest of the rubber mixture which result in actual chemical union, to a greater or lesser degree, between the accelerator

and the rest of the "mix." As a result, the physical characteristics of the resultant product may be, and often are, altered. The physical characteristics of the product may also be affected by the mere continuing presence of the accelerator as a physical constituent of the product, the accelerator imparting to the product some of its own physical characteristics (R., pp. 37, 398-399, 413).

Diphenylguanidine, the preferred di-substituted guanidine of the patent in suit is, as the respondent claims, one of those that improves the physical properties of the cured product over and above the improvement resulting from mere acceleration in the strict sense first above described (R., pp. 398-399, 413).

The physical characteristics that may thus be affected include elasticity and tensile strength. These are obviously qualities of the highest importance in determining the commercial utility of the product. Some accelerators discolor the product—a bad fault, for example, where the product is intended for the soles of white shoes or for similar purposes. Uncombined accelerator remaining in the product will, in the case of some accelerators, cause stains on substances coming in contact with the product. Other accelerators impart undesirable odors to the product and still others are so toxic as to endanger the health of the workmen obliged to handle them.

Effects, such as those above described, can, of course, be determined at the moment when curing is complete. Indeed, the cure is ordinarily said to be complete, or optimum, when the desired group of qualities exist in the product in the highest degree attainable with the particular mixture. *To know anything about the practical utility of the product*, a rubber chemist has to *measure* these qualities *exactly* with laboratory machinery devised for just such purposes. Comparatively small differences in tensile strength, for example, may add a thousand miles to the life of an automobile tire. *To know how to produce the useful product*, the time and temperature (or what is the

same thing—the steam pressure, for steam pressure is a measure of the temperature in the steam-tight vulcanizers) necessary to produce the optimum cure must be *accurately* determined.

In addition to these effects from the use of accelerators over and above their effect in speeding up the union of the sulphur and rubber—effects which can be determined at the moment curing is complete, there are some that can not be so determined. Because the accelerator remains a component part of the product, either in chemical or physical union with the other components thereof, incidental effects from the use of the accelerator may arise subsequently to the completion of the cure: a product, good at the moment of cure, may deteriorate very rapidly (R., p. 38). It is clear that any test made at the moment of cure can give no information on the lasting qualities of the rubber product. It must be allowed to age, either naturally or artificially. In the laboratory, of course, the aging is usually brought about by artificial means.

As already stated the *accurate* determination of the time and temperature and the quantity of a given accelerator necessary for an optimum cure is a laborious and intricate matter for the reason that the group of qualities marking optimum cure must be accurately measured. Accurate determinations are necessary where the practical utility of the product or the mode of producing it is to be determined; but sometimes, when *accurate* determinations are not an object, rubber chemists use the so-called "thumb-and-tooth" method of determining the completion of cure. This consists merely in pinching and pulling the cured rubber with the fingers and in biting it between the teeth.

It must be obvious that such a test, applied to the cured rubber, cannot possibly tell anything accurate as to its useful qualities (Kratz admissions, R., pp. 398-399, 414). Nor can it tell anything of the differences in that respect resultant from the use of different accelerators. These differences, important as they are, are not great enough to be

perceptible by so crude a method. Neither can that method tell anything as to the temperature at which curing starts with the accelerator used and, therefore, anything as to the possibilities of manipulation of the rubber "mix" subsequent to the introduction of the accelerator; or anything as to the protection the particular accelerator will give against overcure; or anything as to the lasting qualities of the product produced by the use of that accelerator. And obviously no accurate determination even of the relative speeds of accelerators can be bottomed on determinations by the "thumb-and-tooth" method of the attainment of cure.

The Court should also note that where the attainment of cure is determined by the observation of the physical properties of the product, whether these are determined scientifically or only by the "thumb-and-tooth" method, no accurate measurement of the speed of the "accelerator" in the strict sense first above noted on page 2 can possibly be made (footnote to Kratz paper, R., p. 838; also p. 414); for the physical properties observed may be the result of the "accelerator's" ability to improve the product over and above the improvement resulting from its capacity to speed the union of the rubber and sulphur. It is apparent that there is an ambiguity in the word "accelerator" (R., pp. 37, 398-399): accelerator, as used in the patent in suit, means a substance *that improves the rubber product* in addition to speeding up the chemical union of the rubber and sulphur. This is abundantly clear even from a casual reading of the patent.

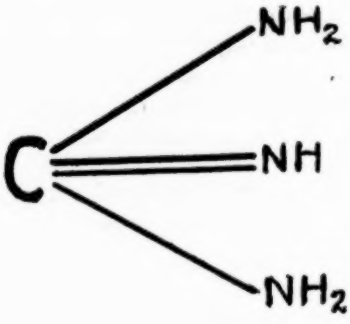
The petitioner seeks to trade on the primary dictionary meaning of the word "accelerate"; but the practical utility of a particular accelerator does not by any means follow from the sole fact that it is very active in speeding up the union between the sulphur and rubber, even if this fact has been accurately determined (R., pp. 658-659). There are many far more rapid accelerators than DPG that were known years before it (R., pp. 417-418); but the United States census figures in evidence in this suit show that the commer-

cial demand is for DPG (R., p. 643). Diphenylguanidine, as petitioner concedes (Pet. br., p. 116), combines more desirable qualities than do other accelerators. It is capable of a wider general use than other accelerators (R., pp. 37 and 662-666) and for the most important uses, such as tire manufacture, it is much the most satisfactory accelerator now available (R., pp. 664-666). Hence, the bitterness with which the petitioner's patent has been disputed.

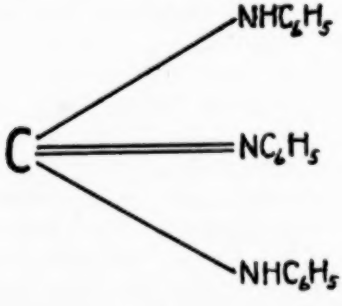
THE STATE OF THE ART PRIOR TO THE WORK OF WEISS.

Up to about the year 1905, the trade had been using inorganic compounds as vulcanization accelerators (R., p. 37). At that time aniline oil, an organic compound, commenced to come into practical use. Subsequently other organic compounds came into general use, especially thiocarbanilide, commonly known as "thio", and hexamethylenetetramine, commonly known as "hexa". The last mentioned was probably the most common accelerator about the time of the incidents involved in this suit. It was objectionable because it poisoned the men who used it. Furthermore, it was not fast enough to protect the rubber from the effect of the heat in the curing. In two scientific papers submitted by rubber chemists in 1916 and 1917, the use of *certain members* of the guanidine family as accelerators was suggested. In this family there are hundreds, if not thousands, of varying compounds of which diphenylguanidine (DPG) is one and the di-substituted guanidines in general, a small group. Some companies had been experimenting with the tri-substituted guanidine, triphenylguanidine (hereafter abbreviated TPG), but aside from the experiments and tests referred to subsequently in this statement of facts no one had, prior to Weiss, employed or suggested the use of the di-substituted guanidines or diphenylguanidine (DPG) of his patent as accelerating agents in the vulcanization of rubber.

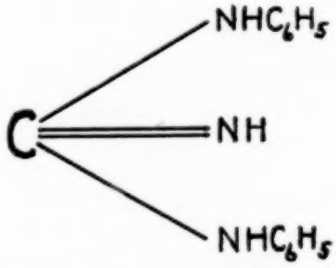
Guanidine is represented chemically by the following symbol:



Guanidine compounds are produced by substituting for hydrogen atoms various so-called radicles. When three hydrogen atoms in the unsubstituted guanidine molecule are replaced by radicles, the resulting compound is known as a tri-substituted guanidine. The replacement of three hydrogen atoms by the phenyl radicle C_6H_5, results in triphenylguanidine represented by the following symbol:



The replacement of two hydrogen atoms results in a disubstituted guanidine. Diphenylguanidine is an illustration of this, as indicated by its chemical symbol given below:



THE CONCEPTION OF THE PATENT IN SUIT BY WEISS.

Late in 1917, Morris L. Weiss, a young struggling chemist who had received a degree from Cooper Union in New York City, entered the employ of the Republic Rubber Company at Youngstown, Ohio. That Company manufactured a variety of rubber articles, some made from pure rubber stock, some from "shoddy," which is reclaimed rubber. At that time, the Company was experimenting with TPG as an accelerator. Weiss was employed to conduct laboratory experiments. His early work was in the field of accelerators, and especially in the testing of TPG.

About March, 1918, he first conceived the idea of using, as an accelerator, the di-substituted guanidine, DPG*, and disclosed that conception to his superior Carlton (R., p. 89). At that time DPG was a laboratory product only. No practical method was known of producing it in quantity. It was necessary therefore before any accelerator experiments could be tried to find out how to make DPG. Weiss commenced eagerly on this research.

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*Diphenylguanidine, which is the accelerator used by the petitioner and the only di-substituted guanidine accelerator used by him, is covered specifically by the Weiss patent claims 8 and 12. For this reason, this brief will be confined mainly to a discussion of diphenylguanidine and these claims. It will be necessary, however, also to refer to the Weiss patent claims 5 and 9, which cover diphenylguanidine generically, because the petitioner has presented false issues concerning them, as to scope and otherwise, in an attempt to induce this Court to make an unfavorable ruling concerning their validity. This will be considered later.

THE EARLY WORK OF WEISS.

In May, 1918, in the Youngstown, Ohio, library, and in June, 1918, while on his vacation in New York, he obtained information from chemistry text books which enabled him to produce a small quantity of DPG (R., p. 103). He first added it to a rubber compound in December of 1918 (R., p. 104). These first tests were unsuccessful, as the slabs of rubber were overcured. The overcure, however, did indicate the speed of DPG and Weiss was encouraged to proceed with his experiments to determine whether DPG rubber, properly cured, would have useful qualities. The first compound used consisted of 50 parts by weight of rubber, 4 sulphur, 2 magnesium oxide, 1 DPG and 43 zinc oxide, and it was cured 50 minutes at 40 pounds steam pressure. "This was the regular standard rubber test recipe" (R., p. 105), and the regular time for cure. *As will appear later, Weiss made a practice of testing each new accelerator on this formula.* A second slab was cured 40 minutes at 40 pounds, but it likewise was overcured. A third slab cured 30 minutes at 40 pounds was also overcured. It was evident that DPG was very rapid; that the time required for vulcanization could be cut in two by its use. He showed the slabs produced by these experiments to Daniels, the chief chemist.

THE FIRST REDUCTION TO PRACTICE.

These experiments used up the original batch which Weiss had been able to produce, but they seemed to him encouraging. He then prepared more DPG. Using the same compound, his first experiment with the second lot was cured 30 minutes at 30 pounds, and still resulted in an overcure. His second slab was cured 20 minutes at 30 pounds. A correctly cured product resulted—the trade expression is an "optimum cure". He then exposed another slab for 15 minutes at 30 pounds. A slight undercure resulted. *After carefully measuring the physical properties of the slab* he con-

cluded that a 20 minute, 30 pound cure was approximately right for the compound he had been using (R., pp. 105-109). *The physical tests showed unexpectedly superior tensile strength, elasticity, and other desirable commercial qualities.* Nothing theretofore known of DPG foreshadowed this result. None of these experiments were recorded until the 20 minute, 30 pound cure was reached. As this seemed to him to be the first successful experiment, he recorded it in his laboratory record book, known as the X-book (R., p. 748).

THE DISPUTED EXPERIMENT.

This successful test appears in the X-book as experiment X-2034E (R., p. 748). There is a dispute as to the day on which it was made. The date noted on the "X" book page reads "2-10-19," indicating February 10, 1919, but the numeral indicating the month has the appearance of having been changed. Weiss was unable to recall having corrected the date but admitted that he might have changed what had been a "1" to a "2" as the result of having inadvertently dated, as one often will, an early February experiment as having taken place in January. The defendant contended that the figure had been changed from a "9" to a "2" and introduced a handwriting expert in support of that contention. If that contention were correct, the date of the experiment would be in September, subsequent to the reading of the so-called Kratz paper before the American Chemical Society, to which extended reference will shortly be made.

The trial judge, quite mistakenly, as respondent contends, accepted the testimony of the handwriting expert and therefore refused to credit Weiss with a successful experiment as early as February 10, 1919. The Circuit Court of Appeals for the Third Circuit reached the opposite conclusion, finding the date shown in the X-book to be the true date.

THE UNDISPUTED REDUCTIONS TO PRACTICE.

However, on February 21, 1919, an experiment concerning which there is no dispute was made by Weiss and recorded in the X-book at page X-2006H (R., p. 731). This experiment was on a shoddy compound. As has been mentioned previously the Republic Rubber Company manufactured many of its products from shoddy. The ordinary shoddy averages about 40% pure rubber. As far as chemical reactions and, especially, the effect of vulcanization accelerators are concerned, experiments conducted on shoddy or on pure rubber are of the same practical and scientific significance. *Again Weiss carefully measured the physical properties of the cured slabs.* These physical tests of X-2006H show marked superiority, as will be shown fully in the argument, over slabs prepared from similar compounds but accelerated with TPG. The superiority of the product was just as significant as the rapidity of the accelerator.

On March 4, 1919, Weiss made a further successful test, likewise undisputed, which he recorded in the X-book page X2042A (R., p. 753). This experiment was also made on shoddy and was made for direct comparison with an actual factory recipe used at that time, which employed one part of litharge as an accelerator. *Again the physical tests of the slabs were made.* The physical tests indicated the superiority of DPG over litharge.

Weiss kept the slabs on his desk under observation after these experiments.

These tests exhausted the supply of DPG which Weiss had been able to produce by chemical processes. They clearly constitute successful reductions to practice on which he was entitled to base his claim to invention. The respondent contends that the invention may be dated at least as early as these three recorded experiments.

THE CONTINUING ACTIVITY OF WEISS.

Thereafter, Weiss was obliged to devote his entire time to work in other lines laid out for him by his superiors. Indeed, his actual tests with DPG had been carried on entirely as a side line to his regular work, which at that time lay chiefly in the development of TPG as an accelerator and of processes for its cheap manufacture. *But he was convinced by the results of his practical tests and devoted himself to perfecting a means of producing DPG commercially.*

Some time during the summer of 1919, Nellen of the Republic Company, gave Weiss a factory recipe to enable Weiss to test out DPG on a factory compound, the particular stock being one used for making washers for oil wells. *On September 6, 1919,* Weiss tried this recipe using TPG as the accelerator, the test being recorded at X-2010H, left hand page (R., p. 736). For purposes of comparison, on September 29, 1919, Weiss used the same recipe, adding DPG for his accelerator. This experiment is recorded at X-2010H, right hand page (R., p. 736).

This incident shows continuing diligence by Weiss with DPG during the summer of 1919 *and prior to September 6,* for Weiss did not know of that recipe until it was given to him by Nellen. Nellen testified (R., p. 231) that at the time he gave the recipe to Weiss it was for the purpose of permitting Weiss to try out DPG in it.

During the summer of 1919, as stated, Weiss was engaged in perfecting a process of producing DPG, which ultimately ripened into a patent, but not the patent in suit. He had proceeded with sufficient success to enable his superior Daniels to have in his possession before September 2, 1919, several hundred grams of DPG. Obviously this was produced only because Weiss and Daniels were convinced that the February and March experiments had successfully demonstrated the qualities of DPG as an accelerator.

THE READING OF THE KRATZ PAPER.

On September 2, 1919, Daniels went to Philadelphia to attend the meeting of the American Chemical Society. At that meeting on some day between September 2nd and September 6th, a paper was read by one G. D. Kratz, a rubber chemist, employed by the Falls Rubber Company. The paper related to vulcanization accelerators and was later published in the Journal of the Society in April, 1920.

It is largely on the information contained in this lecture that the petitioner has based its contention that Kratz and not Weiss was the first inventor of the subject-matter of the patent in suit. The later publication of the paper was no statutory bar, because within two years of the date of the filing of the application.

The part of the lecture around which the controversy centers is a table which Kratz placed on a blackboard and which was copied by some of the rubber chemists attending the meeting, including Daniels, who was Weiss' superior. This table which appears on page 131 of the book of exhibits purports to state the relative speeds of various suggested accelerators in comparison with aniline oil as a standard or base. As appears from this table, the parts required to equal one part of aniline were respectively .500 of TPG and .075 of DPG. It is apparent that the table suggested that TPG was twice as rapid as aniline and that DPG was about seven times as rapid as TPG. The lecturer went on to point out that he had used his accelerators in a compound consisting of 92.5 parts of rubber and 7.5 parts of sulphur vulcanized for 90 minutes at 148 degrees C.

The meeting at which the Kratz lecture was read was attended by the leading rubber chemists of the country, including representatives of Firestone, Fisk, DuPont, and other large manufacturers, all companies that were direct competitors of the company with which Kratz was associated. Kratz stated on the stand that he did not intend by his

lecture to disclose any valuable rubber information to his competitors and his success in this regard is borne out by the fact that none of those present carried away from the lecture anything which he used in his own plant thereafter. In his paper he pointed out that his researches had not been conducted with an eye to discoveries of any practical importance. To Daniels the table showing the speed of DPG compared with other accelerators seemed a confirmation in abstract form of the practical discoveries of his humble assistant. He was impressed by this confirmation, hearing it, as he did, at a meeting of the American Chemical Society and upon his return gave Weiss more freedom to proceed with the DPG work of whose importance Weiss himself had all along been convinced. Numerous successful experiments on various factory compounds are thereafter recorded in the X-book at pages 2010H, 2064D, 2059D, E, F, G, 2065C, D.

THE KRATZ EXPERIMENTS AT NORWALK.

Prior to the delivery of his lecture in 1919, Dr. Kratz had done certain experimental work with accelerators which was introduced by the petitioner as evidence of prior knowledge and use. In 1916 he was an assistant chemist at the Norwalk Rubber Company. Under date of October 31, 1916, he entered in a factory laboratory record the results of some experiments on rubber compounds in which various accelerators were used, including DPG. Under date of November 1, 1916, his records show a table of the comparative speeds of various accelerators. The table shows that DPG is seven times as rapid as TPG (R., p. 953). This, it will be noted, is *exactly* the same ratio as that disclosed in the figures given in the lecture. *The actual speed of DPG relative to TPG is much higher than this.* No practical use was ever made of these results. They were kept quite secret. These experiments are submitted as anticipations. Respondent contends that they cannot be so held because they were inconclusive, secret, and abandoned.

THE ALLEGED FURTHER WORK OF KRATZ.

About a year later, in September, 1917, while in the employ of the Falls Rubber Company, Kratz testified that he accelerated with DPG a batch of rubber compound from which 300 automobile inner tubes actually were made and shipped. This testimony stands alone and uncorroborated. Kratz testified that he disclosed to no one what substance he was putting into the compound (R., p. 393). The plaintiff contends that without corroboration this testimony cannot be accepted as evidence of anticipation; that if the incident occurred, it was entirely secret, and that it must be inferred that it was unsuccessful because it was never repeated or reported. Kratz testified that he experimented further with DPG and other accelerators at the Falls Company plant in 1918. Upon this work Table I of the Philadelphia paper was supposed to be based. This is the only portion of that paper pertinent to the present case. Of this alleged work, no record or corroboration was introduced. It will be shown that the Philadelphia paper contains internal evidence that these tests were never performed at the Falls Company plant in 1918 as testified.

THE ALLEGED BALDWIN EXPERIMENT.

Reliance was also placed upon one other alleged anticipation, the so-called Baldwin experiment recorded in the X-book of the Republic Rubber Company on page X-2005. This experiment is dated February 22, 1917. Baldwin was a predecessor of Weiss at the Republic. According to an entry on the page, DPG was used as an accelerator in this experiment. Weiss testified that this entry did not appear in the X-book during the time that book was in his possession. He was corroborated by numerous witnesses. An examination of page X-2005 shows that the experiment bears no relation to the other tests recorded on that page. Furthermore it was marked "N. G." near the foot of the column. This page of the X-

book was curiously missing for several months prior to the trial in January, 1923, of the *National* case in the Southern District of New York. When found it was shown to have been in possession of counsel for the defendant in that case. It will be shown in the argument that the entry in the X-book contains internal evidence that the DPG entry is an interpolation.

Neither Judge Hough, in *National Aniline* v. *Dovan*, 292 Fed. 555, to which further reference will be made, nor either court herein refers to this alleged experiment. Judge Manton, who tried the *National Aniline* case, thought it a fabrication. (See Appendix, p. 104).

THE ACTIVITIES OF WEISS AFTER LEAVING THE REPUBLIC COMPANY.

In March, 1920, Weiss left the employ of the Republic Rubber Company and made written application for employment with Firestone and with the National Aniline Company. On one of these applications he referred to the Kratz paper, which it is to be remembered had been read before the American Chemical Society, as substantiating the possibilities of DPG as an accelerator and bottomed his request for employment on the fact that he had discovered a process for making DPG cheaply. At the time it was this latter discovery that he believed to be the more valuable. He had been told by a friend that his accelerator discovery was not patentable. Through inexperience he accepted this view and sought no further advice until later.

His reference to the Kratz lecture, the petitioner seeks to construe as an admission that Kratz was the true inventor of the patent in suit, the argument being that had Weiss believed himself to be the inventor, he would have put forth this claim in an application for employment. The event has no such significance. Weiss, unknown and out of work, sought only to gain credence for his own discoveries through refer-

ence to the pronouncements before a learned society. There was no admission that Kratz had invented anything.

Neither Company employed Weiss, and shortly thereafter he appeared in New York, disclosed his inventions to Messrs. Doty and Woodward, who with Weiss thereafter formed the plaintiff corporation for the manufacture of vulcanization accelerators, especially DPG. Activity commenced at once. A factory was obtained in Brooklyn, which unfortunately burned in September, 1921. A new plant was obtained in Newark and was in operation by January, 1922.

THE OBTAINING OF THE PATENT IN SUIT.

During his experimental work at the Republic Rubber Company, Weiss had been advised erroneously by his colleague Stevens that his discovery of the process of using DPG as an accelerator was not patentable (R., p. 168). Weiss was a young Russian with little experience in this country, and he accepted the opinion of Stevens without further inquiry. During 1920 and the early part of 1921, his major interest lay in the successful commercialization of his discovery of a cheap method of making DPG, for which he filed an application for a patent on July 2, 1921, disclosing in the application his discovery of the efficacy of DPG as an accelerator. On November 12, 1921, he filed the application for the patent in suit which issued March 28, 1922.

THE PATENT IN SUIT.

In the patent in suit there are twelve claims. These may be conveniently divided into three groups: Group I—claims 1, 5, 9—relating generically to di-substituted guanidines of which DPG is a type or example. Group II—claims 2, 4, 6, 8, 10, 12—relating specifically to the di-substituted guanidine, DPG. Group III—claims 3, 7, 11—relating specifically to the di-substituted guanidine, DPG, derived from a certain source (thiocarbanilide). The claims cover both the process

of making "compounds of rubber" with the substances just mentioned and the product so obtained.

Group III may be left out of consideration entirely because there was no proof available, and therefore no proof, as to the source of the petitioner's DPG. Of Group II it will suffice to consider claims 8 and 12, the others being generally to the same subject matter. Of Group I it will suffice to consider claims 5 and 9, claim 1 being generally to the same subject matter.

The patent sought and obtained is no new variety, but of the same sort as any other covering advances in the chemical art. The attempt in the brief of the petitioner to make it appear that the Weiss patent is merely upon Weiss' observation that DPG, as an accelerator, has high speed is without justification. The respondent's patent cannot be said to be a "patent of observation" in any sense in which this cannot also be said of every patent for advances in chemical art. In a certain sense, every such patent is a patent upon the observation that when certain substances are brought together, certain chemical reactions ensue between them. In that sense, respondent's patent is a patent of observation; but in no other.

This attempt of the petitioner's to belittle Weiss' achievement goes back to the opinion of Judge Hough in the *National Aniline* case; but it is submitted that a patent cannot be invalidated by reducing it to a striking phrase.

The claims are based on the discovery that di-substituted guanidines, and particularly diphenylguanidine, have practical usefulness in the vulcanization art by reason of their being "particularly effective" and "more powerful and efficacious" as accelerators. The object of the invention is stated to be

> *"to improve rubber compounds so that the finished product shall be of superior quality* and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose." (Italicization added.)

And the added power and the added efficacy claimed for DPG and other di-substituted guanidines are explained as follows:

> "For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizing action but results in a final product much superior in texture, strength, durability and aging qualities over that when the triphenylguanidine is used. A greatly improved product also results when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards elasticity, aging qualities and freedom from 'bloom.' In these and similar instances, it has been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressure than those commonly employed."

* * * * * * * *

> "It will therefore be appreciated that when using the accelerator according to my invention the vulcanization is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness without danger of overcuring the softer or more elastic parts. I have found moreover that diphenylguanidine does not need zinc oxide to shorten the time of cure. I however prefer to use zinc oxide on account of its effects on the physical properties of the products."

The specification also contains the customary type formula and a delineation of the typical procedure.

The petitioner has seized on three lines from the patent—"I have found that diphenylguanidine is much more powerful and efficacious in vulcanization than triphenylguanidine"—and pretends that it states the whole of the patented idea, and that that idea is "that DPG is an accelerator of great activity, of an activity greater than TPG" (Petitioner's Brief, p. 15).

Even on the basis of the lines excerpted by the petitioner, his statement is manifestly false. The claim is not only that DPG *is more powerful, but that it is more efficacious.* Power clearly means speed, but efficacy means something more. The added passages from the patent which have been quoted above explain what is meant.

It must be apparent therefore, that the petitioner's presentation to this Court of the subject matter of this suit is not quite fair.

THE PRESENT SUIT.

As the plaintiff built up a rapidly growing business during 1921, formidable competition appeared. Roessler & Hasslacher took a license in 1922 and up to the time of the decision of the Second Circuit Court of Appeals referred to hereafter, had paid over $90,000 in royalties to the plaintiff. The use of DPG in the industry became widespread. If the patent was valid, it was a most valuable discovery. Rubber manufacturers were eager to defeat the patent and avoid license fees. Dupont, National Aniline, and Atlantic Dyestuff, all powerful producers, chose to fight.

The charge of infringement in the present suit is based on an admitted use of DPG, covered specifically by the "diphenylguanidine" accelerator claims 8 and 12 and generically by the broader "di-substituted guanidine" accelerator claims 5 and 9.

The present case is an "ordinary" patent case involving only issues of fact as to invention, anticipation and infringement. The case could not be in this Court on certiorari but for the fact that the patent in suit, upheld by the Third Circuit, had been previously held invalid in a decision of the Second Circuit in *National Aniline Co.* v. *Dovan Chemical Corp.*, 292 Fed. 555.

The petitioner has sought to give the impression that the respondent's case rests on plainly perjured testimony. That this is not so is perhaps sufficiently indicated by the fact that of the eight judges who have thus far had the patent in suit before them, four have been in favor of and four against the validity of the patent.

The record in the present case, as will be shown in detail hereafter is much stronger in favor of the respondent by reason of the inclusion of additional evidence, than was the record in the *National Aniline* case. This fact alone might be thought sufficient to account for the conflict of the Circuit Courts of Appeal but the argument will show that the Second Circuit failed to grasp the true nature of the patent in suit.

SUMMARY OF THE ARGUMENT.

I.

Weiss is entitled to date his invention of the patent in suit as early as March, 1918, for its conception, and February-March, 1919, for its reduction to practice, under either of which dates he is the first, sole, true and original inventor. The position of the respondent is based on the well-settled principle that a patentee is entitled to date his invention as early as his first practical conception and disclosure thereof, provided thereafter he exercises reasonable diligence in reducing his invention to practice. The evidence in the present case is full and complete as to Weiss' practical conception of his patent in March, 1918, his continuing diligence thereafter and his final successful reduction to practice of February 10,

1919. This successful test was followed by two others on February 21st and March 4th. The testimony of respondent's various witnesses in this case and his documentary evidence dovetail in an unusual degree. Respondent's detailed consideration of the matter in the argument shows that there is not the shadow of a ground for petitioner's attack on the credibility of respondent's witnesses, and the evidence of these witnesses should be accepted in full, including that as to the disputed test of February 10, 1919. But even if there were ground for the attack upon that entry, respondent ought still to prevail, since the tests of February 21st and March 4th, 1919, are undisputed and constitute a clear reduction to practice within the meaning of the patent law. The attempt of the petitioner to explain away these successful reductions to practice is shown in the argument to be without foundation in the evidence and completely inconsonant with reason and common sense.

II.

None of the defenses based on instances prior to the Kratz paper of September 6, 1919, defeat the patent. These defenses are (a) admitted laboratory tests by Kratz at Norwalk in 1916; (b) a single alleged actual use of DPG by Kratz for the acceleration of a mix for three hundred tubes at the Falls Rubber Company in 1917; (c) alleged laboratory work at the Falls Company in 1918 by Kratz; (d) an alleged experiment by Weiss' predecessor at the Republic Rubber Company; and (e) certain references in papers published by King, Twiss and Du Bosc.

Kratz's early work at Norwalk is shown to be inconclusive, secret, inexact and abandoned. The alleged manufacture of three hundred tubes at the Falls Rubber Company in 1917 rests on the uncorroborated testimony of Kratz. It is shown to have been secret and is admitted to have been quite at variance with the usual factory routine. It was an isolated experi-

ment, unrepeated and abandoned. The occurrence is unexplained and unexplainable. The whole instance smacks of improbability and, standing as it does on the uncorroborated testimony of a rival, fails to meet the burden of indubitable proof of an anticipation placed upon one attacking a patent. The alleged subsequent experimental work of Kratz at the Falls Company in 1918 is quite as inexact and inconclusive as his work at Norwalk in 1916. It was in no sense a reduction to practice and the stated results of these experiments when compared with those admitted to have been performed at Norwalk in 1916 show that the experiments never could have taken place. The evidence for them, also, is merely the uncorroborated testimony of Kratz. The defense is clearly insufficient and insufficiently proved. The respondent in the argument shows that the alleged anticipation by Weiss' predecessor at the Republic Rubber Company is, as found by Judge Manton in the *National Aniline* case, a fabrication. The evidence on this point is internal to the alleged record of the experiment and is conclusive. Moreover, the experiment was admittedly isolated, and was marked "N. G." in the alleged record thereof. As to the papers of King, Twiss and Du Bosc, it is sufficient to say that they do not actually refer either to DPG or the di-substituted guanidines but to entirely different substances.

III.

The Kratz paper, the chief reliance of the petitioner, professes to be merely an embodiment of the results of the alleged experiments at the Falls Rubber Company in 1918. It is probably based largely on the Kratz experiments of 1916 at Norwalk. The disclosures in the lecture were inexact from a scientific point of view and inconclusive from a practical point of view. In both the Norwalk experiments and those at the Falls Company determinations of cure were made by the crude "thumb-and-tooth" method. Kratz himself admitted

the inaccurate and misleading character of his figures and professed to be uninterested in practical results. There is no evidence that the information in the paper was ever put to any practical use anywhere except the improbable story of Kratz as to the making of the tubes at the Falls Rubber Company in 1917. Not only does an examination of the technical contents of the paper show that it was insufficient to constitute an anticipation of the patent in suit, but the consensus of the expert testimony at the trial was to the same effect as is also the inference to be drawn from the behavior of those who heard, or heard of, the paper.

IV.

The Weiss patent discloses patentable invention. Whatever plausibility the petitioner's argument on the point of invention may seem to possess rests on the similarity of the names, "diphenylguanidine" and "triphenylguanidine". These similarities in name mean nothing in terms of practical usefulness as is conclusively shown in argument that follows. The presumption of validity arising from the issue of a patent is unusually strong in the present case because of Weiss' frank statement in his application of the exact state of the art prior to his work. The disclosure in the Weiss patent is twofold—speedy curing of the compound, and improvement of the resultant product. If either shows patentable novelty, the patent must be sustained. Petitioner makes no attempt to attack the patentable novelty of the second of these disclosures. Instead he seeks to reduce the patent to the former only. The Weiss invention is shown to have required more than mere mechanical skill and shown to have constituted more than a substitution of materials. The petitioner's argument fails to take any account of the essential quality in any discovery which the patent law strives to protect, to wit, the utility thereof to the public. This utility is conclusive where any doubt exists as to patentable inven-

tion according to the accepted criteria for judging of that matter. There is no reason to doubt the patentability of Weiss' invention under any of the recognized criteria; but if patentable invention did stand in doubt, it is clear that the utility of the Weiss patent should determine this issue in favor of the respondent. The evidence as to the utility of the Weiss patent is full and conclusive. Approximately 2,000,000 pounds of DPG were used in 1925. Nor did the decision of the Circuit Court of Appeals result from that Court's confusing the patent in suit with Weiss' patent for the cheap commercial manufacture of DPG. The excerpts from the opinion of the Court below upon which petitioner relies to establish this confusion have been torn so violently from their context as to destroy their original meaning. The two patents are related though not identical. It is not disputed by petitioner that Weiss was the first man to effect a process for the cheap commercial manufacture of DPG. Kratz did nothing. Weiss, not by accident, but by long and persistent endeavor, worked out a process for the commercial manufacture of DPG. In view of this, there can be no doubt as to who really discovered the practical usefulness and, therefore, saw the commercial demand for DPG.

ARGUMENT.

POINT I.

Weiss is entitled to date his invention of the patent in suit as early as March, 1918, for its conception and February-March, 1919, for its reduction to practice, under either of which dates he is first, sole, true and original inventor.

Before discussing the evidence in the record under this point a brief reference to the authorities will indicate the position of the respondent. It is well settled that a patentee is entitled to date his invention as early as his first practical conception and disclosure thereof, provided thereafter he exercises reasonable diligence in reducing his invention to practice. If such diligence is not established reduction to practice is the earliest date that he may claim.

In *Christie* v. *Seybold*, 55 Fed. 69, 76, the present Chief Justice, delivering the opinion for the Circuit Court of Appeals for the Sixth Circuit, after reviewing the authorities upon the subject, stated the rule as follows:

> "It is obvious from the foregoing that the man who first reduces an invention to practice is prima facie the first and true inventor, but that the man who first conceives, and, in a mental sense, first invents, a machine, art, or composition of matter, may date his patentable invention back to the time of its conception, if he connects the conception with its reduction to practice by reasonable diligence on his part, so that they are substantially one continuous act."

In *Merrow* v. *Shoemaker*, 59 Fed. 120, 122, Circuit Judge Dallas stated the same principle in the following language:

> "The complainant contends that he disclosed his invention and so described its details that it was fully understood by the persons to whom he disclosed it, prior

> to June 16, 1887. If so, he has established his date of invention as not later than that day, and the question of anticipation must be solved with reference thereto, provided that he was duly diligent in filing his application for a patent, and in constructing his machine."

The subject was again elaborately reviewed by the Circuit Court of Appeals for the First Circuit in *Automatic Weighing Machine Co.* v. *Pneumatic Scale Corp.*, 166 Fed. 288, 301. Therein, Judge Colt stated that the rule was a result of the amendment of the patent statute by Section 15 of the Act of July 4, 1836 (5 Stat. 123). He said:

> "This amendment introduced a new and just principle into the patent law, inasmuch as it protected the first conceiver of the invention by permitting him to carry back the date of his invention to the time of his drawing and disclosure, provided he was using reasonable diligence in adapting and perfecting his invention."

This Court gave its sanction to this doctrine in *Loom Co.* v. *Higgins*, 105 U. S. 580, 594.

From the foregoing it is apparent that if the Weiss experiments of February and March, 1919, amounted to a reduction to practice, he is entitled to date his invention as of that time, and further, subject to the exercise of reasonable diligence in perfecting his invention, he is entitled to go back to the date of his first mental conception and disclosure to Carlton in March, 1918.

For purposes of the present case either date is satisfactory to the respondent, since the major defense is based upon the Kratz lecture of September, 1919, and since other alleged defenses are based on experiments conducted prior to March, 1918.

(a.) THE EVIDENCE.

The First Conception of the Invention.

In March, 1918, Weiss had been in the employ of the Republic Rubber Company of Youngstown, Ohio, for several months as a research chemist. He was a subordinate in the laboratory, confined in his activity to the work laid out for him by his superiors. The company was engaged in the manufacture of rubber articles, and a substantial part of its output consisted of products made from shoddy, *i. e.*, reclaimed rubber, averaging about 40% pure rubber.

The various commercial accelerators then in use were subject to various defects—some to one defect, some to another (R., p. 39). It was known that the shortening of the curing process was not only itself an economy but that it resulted in an improved product by preventing the breaking down of the the rubber from exposure to heat, *i. e.*, so-called depolymerization; and further that *certain* accelerators were capable of imparting improved qualities to the product in varying degrees apart from the results merely of speeding up the process (R., p. 37). Rubber chemists were seeking, therefore, not merely faster accelerators, but accelerators capable of imparting to the product these improved qualities. Mere speed in an accelerator was not enough. Faster accelerators than DPG were known even then. (See Cranor's paper, Plaintiff's Exhibit 23, R., p. 783, and testimony of Kratz, R., p. 417.) Superior quality of the product was not *necessarily* related to speed. A more detailed consideration of the requisites of a *commercially usable* accelerator will be found at pages 1-9 of this brief.

At this time the chemists at the Republic Company were engaged in an attempt to develop new accelerators and processes for manufacturing them. Weiss' chief superior was Monroe H. Daniels; his immediate superior, Clinton A. Carlton. Carlton left the employ of the company in the latter

part of March or the early part of April, 1918 (R., p. 90). *This date is important* because Carlton testified (R., p. 93) that shortly before he left, Weiss explained to him his belief that DPG had the qualities requisite in an accelerator, at least that it was sufficiently promising to warrant experiment with it. Weiss fixes the date of this disclosure as some time in March, 1918 (R., p. 89).

It does not appear certainly that Daniels was informed of Weiss' idea at this time; but he evidently soon learned of it, for he testified that toward the end of 1918 Weiss told him that he had an idea "about the *production* of DPG," and that he told Weiss to go ahead if he had such an idea, "because I felt that we ought to have just as many accelerators in the plant, and have the use of them, as we could possibly get" (R., p. 204).

This instruction of his clearly indicates that Weiss had already convinced him that DPG might be a speedy and effective accelerator in the improvement of rubber products. It is evident, then, that Weiss is corroborated by both his superiors in his testimony that in 1918 he conceived the idea of the patent in suit and disclosed it to Carlton and Daniels.

The Early Experiments and the First Success.

Weiss expected to test his conception by actual experiment but it was necessary first to devise a means of producing DPG. At that time, it was a laboratory product, not obtainable in the market. In May, 1918, he searched in the public library at Youngstown for a method of preparation (R., p. 102), and later in June of that year while on his vacation in New York, he obtained additional information from which he was able to start the actual preparation of DPG in September, 1918. Upon the departure of Carlton, however, Weiss' duties increased and in consequence he was limited in his work on DPG to what spare time he could find (R., p. 103).

After several experiments in methods of production, he finally obtained about five grams which he proceeded to test out in a rubber compound. It is to be noted that the formula on which he first tested DPG was the one habitually used by him for first tests with a new accelerator. *Throughout the X-book every new accelerator tried by Weiss appears first to have been tried out in this compound.* It consisted of 50 parts of pure rubber, 43 zinc oxide, 4 sulphur, 2 magnesia, plus the accelerator. For his first test he used one part DPG and cured the "mix" for 50 minutes at 40 pounds steam pressure, a normal time with then known accelerators. An overcure resulted (R., p. 105). This convinced him that the accelerator he was using was more powerful than those then in use in the industry.

Weiss was assisted in this experiment by William Halliday, a laboratory handy-man, who testified that he recalled the series of experiments by Weiss now being recounted (R., pp. 234, 235).

Halliday did not testify in the *National Aniline* case.

His second experiment with the same compound was cured 40 minutes at 40 pounds. It resulted in another overcure (R., p. 105). A third at 30 minutes and 40 pounds likewise was overcured (R., p. 107). It was clear that the time for cure could be cut at least in half with DPG.

These three tests exhausted the DPG on hand, and in the preparation of an additional quantity, Weiss improved his production process (R., pp. 107, 108). With his new supply, he again cured the same mixture, this time for 30 minutes at 30 pounds, and again obtained an overcure, although this time the overcure was not so marked as in the first three tests (R., p. 108). In his next test with the same compound for 20 minutes at 30 pounds, he obtained an excellent cure. He then cured a batch for 15 minutes at 30 pounds but the product was undercured (R., p. 109). *The slab of rubber resulting from the successful cure, he then tested in a physical laboratory for tensile strength, elasticity, etc., and from the*

unusual results of these tests, concluded that he had found approximately the right combination. Thereupon he recorded his test in the X-book, kept by him in the laboratory at page X-2034E (R., p. 748). This is the test which bears the disputed date. The figure indicating the month appears to have been changed. It now reads February 10, 1919. A special discussion of this date is deferred at this point.

From this testimony it appears that there were at least six tests made during December, 1918, January and February, 1919, one of which was recorded. However, after completing the first three tests, Weiss showed the rubber slabs which had been overcured to Daniels, and told him his impression of the results and that he was starting to prepare more DPG in order to continue his tests (R., p. 111). This testimony is confirmed by Daniels (R., p. 204).

The Later Successes.

His next experiment appears at page X-2006G. (R., p. 731). It is not dated but from its column position in the X-book it is obvious that it took place prior to February 21, 1919, the date of X-2006H. In this test two parts of DPG were employed and an overcure resulted. The test was made for purposes of comparison with X-2006B, made July 26, 1918, in which TPG had been used (R., p. 114).

Thereafter two tests of DPG were made and recorded *concerning which there is no dispute.* One, appearing on page X-2006H, was recorded on February 21, 1919 (R., p. 731). It was made on a shoddy compound then in actual use in the Republic factory.

On the same day he made two other tests with the same compound, in one of which (X-2005H) no accelerator was used, and in the other (X-2005G), TPG (R., p. 731). A comparison of the physical test figures of the slabs resulting from these three tests shows the marked superiority of DPG. For purposes of convenient comparison the records of these three tests are set forth below:

	DPG 2006H	No Accel. 2005H	TPG 2005G
C. Shoddy	70	70	70
Br. Crepe	5	5	5
Lime	1	1	1
Sulphur	4	4	4
D. P. G.	2	..	..
Barytes	18	20	17
T. P. G.	..	..	3
	100	100	100
Cure	15/30	35/35	20/35
Stretch	10¼	11¼	11
Tensile	720	615	525
Set	⅝	¾	18/32
Date	2-21-19	2-21-19	2-21-19

The figures after the word "Cure" refer to the time and steam pressure, "15/30" meaning 15 minutes at 30 pounds. The word "Tensile" means tensile strength, and is the pull in pounds required to break a sample of rubber of standard cross-section by stretching it to the breaking point. *It is the most important physical quality in commercial rubber.* The left hand column indicates the greatly increased tensile strength of the product cured with DPG.

The figures for "Stretch" represent the number of inches to which a standard length of cured slab (usually two inches) can be stretched before breaking. Elasticity in shoddy compounds is always less than in compounds made from pure rubber. The qualities desired in shoddy compounds are toughness and strength which are related to tensile strength.

The figures for "set" are fractions of an inch. The same standard length of cured slab (two inches) is stretched almost to the breaking point, held at this point for several minutes, and then released. It does not contract quite to its original length. The length of the increment is the amount of the "set". Its absence, not its presence, is desired in a commercial product. As appears from the above figures the "set"

for the DPG slab and that for the TPG slab were about the same.

In the tensile strength of the product and in the time required for cure, two very important factors, DPG was markedly superior. Comparing the left hand and the right hand column, it will be seen that using 2/3 as much DPG as TPG, and curing for ¾ the time at 6/7 the pressure, a product having 37% greater tensile strength was obtained.

Again on March 4, 1919, another undisputed test was made, X-2024A (R., p. 753), with DPG. Again a shoddy compound was used.

This test was made for purposes of direct comparison with X-2042 blank (R., p. 753), recorded on the same day, in which one part of litharge was used as accelerator in exactly the same compound as that used in X-2042A. The comparative results of these two tests are set forth below:

	Litharge 2042 Blank	DPG 2042-A
G. Shoddy	68	68
Hydrolene	10	10
Turps	3	3
Fossil Flour	12	12
Inertia	1½	1½
Lime	2¼	2¼
Sulphur	2¼	2¼
Litharge	1	..
D.P.G.	..	1
	100	100
S. G. (Specific Gravity)	1.64	1.60
Cure	38/274	20/274
Stretch	3½	3½
Tensile	530	620
Set	⅛	⅛
Date	3-4-19	3-4-19

Here the stretch and set, as before, were equal; but the rubber cured with DPG had 90 pounds greater tensile strength,

though cured for but little more than half the time. The "274" in these tables means 274° F., which is about the equivalent of 30 pounds steam pressure.

The fact that these tests were made on shoddy compounds does not militate against their conclusiveness. Shoddy is reclaimed rubber. Old tires, hose, etc., are accumulated, treated so as to remove the sulphur, and reduced to a plastic mass. The percentage of pure rubber is from 30-75%. The X-book abounds in experiments made on shoddy compounds. The same accelerators are employed in them as in pure rubber compounds. The process of cure is the same. The chemical reactions are sufficiently alike to disclose the worth of an accelerator. There is not an iota of evidence in the record that accelerators cannot be tried out as effectively on shoddy as on virgin rubber. The story told by the X-book is all the other way.

Both of these shoddy tests were made on compounds actually in use in the production of commercial rubber products by the Republic Company. The figures speak for themselves. To the layman they convincingly demonstrate the marked superiority of DPG. To Weiss, a rubber chemist, they abundantly confirmed the accuracy of his discovery. Their success was to him a convincing practical application of what he had conceived and disclosed to Carlton nearly a year before. They showed him that he had an accelerator that would work better in shoddy compounds than anything he had known before. This was a goal he had been steadily seeking (R., pp. 116, 205, 613). There can be no doubt that they constitute a reduction to practice within the meaning of the patent law.

(b) THE PETITIONER'S ATTEMPT TO EXPLAIN AWAY WEISS' SUCCESSES.

Only one serious effort was made by the petitioner to rebut the conclusion of superiority that these figures show. That

was the testimony of Bridgewater, a DuPont chemist, allied with a company eager to defeat the patent. The value of his testimony may be gathered quickly from comparative tables. He referred first to tests X-2006H and X2005H, set forth *supra*, page 33, and pointed out that the DPG compound resulted in 105 pounds greater strength than the no-accelerator compound (R., p. 494). He neglected to mention the fact that the DPG compound was cured in 15 minutes as against 35 for the other, and at 30 pounds pressure as against 35. Nor did he point out that on the same day 50% more TPG in the same compound resulted in a slab 195 lbs. weaker.

He then considered X-2006 Blank and X-2006B which are set forth below:

	Litharge X-2006 Blank	T.P.G. X2006B
C. Shoddy	93	93
Lime	1	1
Litharge	3	..
Sulphur	3	3
T.P.G.	..	3
	100	100
Cure	30/40	15/40
Tensile	430	730

These tables plainly show the superiority of TPG over litharge in this particular compound. But the learned Mr. Bridgewater drew the amazing conclusion that because TPG was superior to litharge in a compound based on 93 parts of C. Shoddy and 3 of sulphur, TPG must be superior to DPG, because DPG had been only 105 pounds better than no accelerator in a *different* compound consisting of 70 parts of D. Shoddy and 4 of sulphur, cured for *different* times under *different* pressures (R., p. 495). The comparison obviously is made between altogether different tests having no relation to one another.

Petitioner further seeks to have this court infer from the behavior of the Republic Company that Weiss' work prior

to the reading of the Kratz paper September 6, 1919, was wanting in conclusiveness and that it was that paper which changed things at the Republic Company. The fact that during this period the Republic laboratory was engaged chiefly on TPG is emphasized as well as the fact that the Republic Company contemplated the erection of a TPG plant. This it is contended was changed after Daniels heard the Kratz lecture. His caution thereafter to Stevens, one of his assistants, not to spend too much time in the future on TPG is quoted: "Diphenyl is the Kingpin now".

This argument of petitioner's seems plausible enough unless it is remembered that *Kratz's statements in his paper showed that MPG was just as good as DPG.* If the petitioner wishes to make a behavioristic approach, it must be thoroughgoing. It must explain the exclusive concern of the Republic Company with DPG when Kratz said MPG was just as good. To respondent it seems that the behavior of Daniels and those in charge at Republic shows just one thing, that Kratz's paper convinced them that what the humble Weiss had been telling them was true—that DPG really was the King pin. This conclusion is fortified by the further fact that although many learned chemists heard, or heard of, the Kratz paper, only at Republic did any work on DPG ensue. Prior information seems the only explanation of this behavior.

The petitioner's discussion tends to blind the reader to the fact that the question is not whether Daniels and others at Republic were actually convinced in 1918-19 by what Weiss told them but whether as competent chemists and reasonable men they should have been. In this view Daniels' alleged admission that he told his superior Clark that he "wasn't prepared to say how good it (DPG) was" becomes unimportant. It is submitted that the analysis of Weiss' results already given shows that Daniels and others at Republic should have been convinced of the practical efficacy of DPG, whether they were or not.

Neither should the fact be obscured in the mind of the court that it was only necessary that these February-March, 1919 experiments by Weiss be conclusive as to the *efficacy* of DPG as an accelerator. Invention does not depend on *superiority*. Efficacy and utility are the contributions to the arts which the patent laws protect. The tests showed superiority but mere efficacy would be enough.

(c) FACTS AND EVENTS CORROBORATIVE OF WEISS' CONCEPTION OF HIS INVENTION IN MARCH, 1918, AND ITS REDUCTION TO PRACTICE IN FEBRUARY-MARCH, 1919.

The corroboration of Weiss by Carlton, Daniels and Halliday was further buttressed by the affidavits of Messrs. Seil and Greenwald, executed long before this patent litigation arose, at the time of the application of Weiss for the patent. Seil's affidavit (R., p. 904) states that prior to the month of April, 1919, he met Weiss in Youngstown and in the course of a conversation about accelerators for rubber compounds, Weiss told him that he had been working on the production of DPG as an accelerator and that DPG had proved to be very efficient for that purpose. This affidavit was executed on February 23, 1922.

Greenwald's affidavit, executed February 24, 1922, states that some time between October 26, 1918, and May 6, 1919, while serving as a Lieutenant in the Sanitary Corps, at Camp Meade, Maryland, he received a letter from Weiss from Youngstown offering him a sample of DPG for experimental work and stating that DPG had been produced by him for use in the acceleration of the vulcanization of rubber compounds (R., p. 905). Greenwald had been an associate of Weiss from 1912 to 1916 in the Harriman Research Laboratory and in another laboratory in New York (R., p. 87).

Subsequent events likewise corroborate the facts just stated. During the summer of 1919, Weiss was busy on his method of manufacturing DPG (R., p. 206). During the sum-

mer of 1919 he prepared several hundred grams. This was in the laboratory and available for the use of himself and of Daniels (as the latter testified) *before* the latter attended the meeting of the American Chemical Society in September, 1919, when the Kratz lecture was delivered (R., pp. 206, 210). Several hundred grams of this uncommon chemical would not have been produced unless its utility in the industry served by that laboratory were known. Nor would Weiss have labored to perfect his process for the manufacture of DPG, had he not been convinced of its commercial utility. This process was perfected when he left Republic in March, 1920.

Commencing in April, 1918, the X-Book shows many substances tested and recorded by Weiss as possible accelerators, and all in the standard rubber accelerator test recipe. It is very significant that though he tested many substances to find what he was looking for prior to February 10, 1919, yet when he recorded the very successful result with DPG of that day on page 2034E, he believed he had found the ideal accelerator he was searching for, because the X-Book shows that from *then* to the end of his employment with Republic he did not prepare for test *another single substance* as a possible accelerator. Thereafter his effort was directed to making this excellent accelerator commercially available by perfecting a process for its cheap manufacture.

(d) THE PETITIONER'S ATTACK UPON THE CREDIBILITY OF RESPONDENT'S WITNESSES.

[NOTE: *Before going into this matter, respondent would like again to call the Court's attention to the fact that the two shoddy tests of February 21, 1919 and March 4, 1919, which are undisputed constitute a clear reduction to practice before the Kratz paper of September 6, 1919.*]

Nellen.

The petitioner did not cross-examine Nellen. He now attacks Nellen's testimony as amounting to nothing for the

reason that although Nellen remembered and testified that Weiss had spoken to him of the use of DPG as an accelerator, he could not place the date any more exactly than sometime between February 1 and November 1, 1919.

Petitioner has nothing to say as to the rest of Nellen's testimony which was to the effect that Nellen had given to Weiss during this period at the latter's request for use in testing DPG the formula shown on Plaintiff's Exhibit No. 5, to be found at R., p. 721. Cf. R., p. 199. The witness identified the exhibit as being in part in his own handwriting. He stated that he had given it to Weiss in response to the latter's request for a cheap shoddy formula in actual use in the factory upon which to try DPG (R., pp. 230-231). Nellen could not say as to the date closer than already noted but Weiss testified that the occurrence was "late in the summer of 1919" and "sometime in August 1919" (R., p. 118).

Therefore if it can be shown that Weiss was not lying it will be helpful in combatting the petitioner's attack on Weiss' credibility as well as corroborative of Weiss' testimony that he was working with DPG in the summer of 1919 prior to the delivery of the Kratz paper on September 6, 1919.

If the Court will turn to page 736 of the record and observe the test recorded in column H of the left-hand photostat and will compare that formula with that in Plaintiff's Exhibit No. 5, it will see that they are identical with the exception of the amount of filler (zinc oxide) used and the amount and the kind of accelerator. In the test recorded in the left-hand X-2010H at page 736 of the record, the accelerator is "Trifan", which was the factory code name for TPG (R., p. 119), whereas in the original formula given to Weiss by Nellen the accelerator is "cromite", the factory code name for "thio" (R., pp. 187 and 229). In substituting TPG for "thio" the parts of accelerator had to be cut from 4 to 1 and the parts of filler (zinc oxide) increased by 3 to keep the total 100 in accordance with the usual practice.

The date of the test recorded at page 736 of the record is September 6, 1919. Thus it is established that on the day Daniels was in Philadelphia listening to Kratz (R., p. 228) Weiss was in Youngstown working with this formula gotten from Nellen, by Nellen's testimony, for use with DPG. Thus Weiss is corroborated in his testimony to the extent that the time of his speaking to Nellen was before the Kratz lecture and Nellen's testimony, contrary to petitioner's assertion does corroborate Weiss as to his work upon DPG in the summer of 1919 prior to the Kratz lecture.

Halliday.

Petitioner's objection to Halliday's testimony is that Halliday undertook to pick out a single test from among thousands with nothing unusual in the test so singled out to earmark it and fix it in Halliday's mind. The petitioner would be right in its position if it were right in its facts; but it appears from Halliday's testimony that there was a great deal to fix the particular series of tests in his mind.

It seems Halliday, the compound mixer, resented the fact that Weiss checked up carefully on his mixing, thinking that it impugned his own accuracy. Therefore when the first of the DPG test slabs came out badly overcured, he was glad of the opportunity to gloat over his superior; but much to his surprise Weiss persisted with the apparently "rotten mix", asking for more cures until a good one was gotten. The unusual shortness of the successful cure plus his lost opportunity to gloat over Weiss seems to have fixed the occurrence in his mind.

Carlton.

The attack on Carlton's credibility is to be found at the bottom of page 39 and the top of page 40 of petitioner's brief. It will be seen that the attack is based on some alleged inconsistency between the affidavit to be found at page 1003

of the present record and a certain other affidavit alleged to have been executed in the *National Aniline* case. The latter affidavit is not among those parts of the *National Aniline* record printed as a part of the record in the present case. Neither is there any reference to it in the *National* record. In addition, the nature of the inconsistency between the two affidavits is not stated. Under the circumstances, respondent is at a loss how to make answer.

Daniels.

There are three attacks on Daniels. The first is that he and his superior, Clark, were at odds in their testimony as to whether there was discussion as to dismissing Weiss from the employ of the Republic Rubber Company during 1919 and, also, as to whether Daniels told Clark during the spring or summer of 1919 of Weiss' work on DPG. It seems unnecessary to call either man a liar in accounting for this inconsistency. The matters testified to were at the date of the trial six or seven years in the past. Either may well have been honestly mistaken and it is an open question as to which was in error.

The second attack on Daniels' credibility is based on an affidavit given by him in the *National Aniline* case and reproduced at page 999 of the present record. In that affidavit Daniels referred to the undated experiment entered at page X-1777, column "blank" of the Republic X-book (R., p. 724), as having been performed in the early part of 1919. At the trial in the present case he testified that it had been performed the latter part of 1919 or the first part of 1920. It is stated that the adjacent pages show from a cursory inspection that the experiment must have been as he testified at the trial and not as he swore in the affidavit made in the *National Aniline* case.

This is simply not so. If the Court will run over the pages from the X-book reproduced in the present record, it will be seen at once that there is no coincidence between the numeri-

cal sequence of the pages of the X-book and the chronological sequence of the experiments.

This is shown by the following examples:

Page of X-Book	*Page of Record*	*Date of First Entry*
X-2019	741	11/27/17
X-2021	742	10/11/17
X-2026	644	6/11/18
X-2027	745	2/27/18
X-2050	757	8/28/19
X-2051	758	8/20/17
X-2053	759	19/3/19
X-2055	760	8/25/17

The above dates are in every case the first entry on the pages in question. There are many other examples of this sort in the record.

The entry in question is the first, last and only one on the particular page.

The petitioner says respondent's counsel said this variance in Daniel's testimony was inconsequential. Respondent's counsel has no recollection of making any such assertion; but it was said below and, respondent still believes, that Daniels made a simple error in the date of an occurrence some six years in the past. He truthfully corrected the error in his testimony in the present case and it is submitted that his action in so doing should not discredit him.

The final objection to Daniels is that he deliberately deceived the Patent Examiner and thereby induced him to issue the patent in suit. This is a serious charge if true. It is based solely on the fact that in the affidavit filed by Daniels in the Patent Office in connection with Weiss' application for the patent in suit, Daniels stated (R., pp. 909-910):

> "During the early part of the year 1919 said Weiss produced diphenylguanidine as an accelerator for rubber compounds, and during the early part of that year made numerous tests of the same as an accelerator in vulcanizing rubber. These tests were also carried out in the

compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods."

Respondent concedes that the language quoted can carry the meaning for which the petitioner contends, to wit, that DPG was used in the actual manufacture of commercial products at the Republic Rubber Company. But it must be remembered that Daniels executed this affidavit with full knowledge that the X-books contained the true story and that other persons at the Republic Rubber Company were conversant with the facts. It seems incredible that under these circumstances he would consciously pervert the truth. It must be remembered, in addition, that it was not necessary in order to enable Weiss to obtain his patent that the affidavits filed should declare that DPG had been used in the actual manufacture of commercial products. It was necessary only that they declare that tests had been made demonstrating its efficacy for that purpose. Daniels knew that DPG had been actually used in vulcanizing rubber compounds of exactly the sort which would be used for making "rubber goods, such as, tires, belts, valves and other commercial goods". While respondent concedes that the thought is awkwardly expressed in the affidavit, it submits that the only view really tenable is that Daniels meant to say that DPG had "proved to be highly efficient as an accelerator" for the purpose of "actual vulcanization of rubber goods, etc.". It should not be overlooked that the affidavit is typewritten. The ineptness of expression may be due to a typist's error which Daniels failed to notice before signing the affidavit. At any rate, since the use in the actual manufacture of hose, tires, etc., did not need to be declared in order for Weiss to obtain his patent, it is submitted that petitioner's charge that the patent in suit was procured by a

misrepresentation of the essential facts is quite without foundation.

It is not without significance that Daniels was not confronted with this affidavit on cross-examination at the trial and then given an opportunity to answer the charge of dishonesty laid to him by the petitioner.

Weiss.

The first ground for impeachment of Weiss' testimony upon which petitioner relies is the fact that Weiss failed to recollect exactly what time in the June seven years previous to the trial he had taken his vacation. (Pet. br., p. 40.) Surely such an error is no ground for impeaching the credibility of a witness.

The next complaint (Pet. br., p. 40) is that at the trial Weiss testified that he had made five grams of DPG in September, 1918, and had tested it on rubber compounds in December of that year, whereas in an affidavit filed in the *National Aniline* case he stated that, on the basis of information gleaned at the New York Public Library on his vacation in June, 1918, he prepared a small quantity of DPG at Republic in September, 1918, but that the amount prepared at *that* time was not sufficient to permit a test in a rubber compound. Counsel for petitioner characterize this as "an unexplained and unexplainable variance on the all-important point of when Weiss first made DPG, etc." They say Weiss admitted the inconsistency of his testimony. *As a matter of fact,* in his answer to XQ247 on page 143 of the Record, Weiss refused to admit that the affidavit was not reconcilable with his testimony at the trial of the present case. That answer should be compared with his answer to Q56 on page 103 in which he states that he made *two* experiments in the preparation of DPG in September, 1918, one of which was discarded, but that when he got through, he had about five grams of DPG.

The same complaint is made (Pet. br., p. 44) as to inconsistency between the date given in the affidavit for the making of the second batch of DPG and the date given for that work in Weiss' testimony at the trial. (Pet. br., pp. 44-45.) The affidavit states (R., p. 143) that in September, 1918, he "did not have sufficient data to produce any *considerable* quantity of diphenylguanidine" (italics ours) and that in January, 1919, he visited the library of the Carnegie Institute in Pittsburgh and obtained information as to various laboratory methods of making DPG and that upon his return to Youngstown in the middle of January he prepared sufficient DPG and tested it out soon thereafter in a rubber compound. The testimony alleged to be inconsistent is to the effect that Weiss made his *second* batch of DPG before the Pittsburgh trip. Obviously the affidavit does *not* say the *second* batch was made *after* the trip. It doesn't *mention* the *second* batch. Weiss pointed this out clearly on cross examination and also the fact that the language in the affidavit dealt with his efforts to perfect a means of producing DPG in *"considerable"* quantities—*i. e.*, with the development of his invention for the cheap production of DPG, covered by a patent not here in suit. There is no "unexplained or unexplainable variance" involved anywhere save in the imagination of counsel for petitioner.

Counsel for respondent request the court to read carefully in the light of what has been said Weiss' cross-examination (R., pp. 141-145). Counsel feels that the record tells its own story.

Complaint is made (Pet. br., p. 45) of Weiss for not having recorded in the X-book his early experiments prior to February 10, 1919, despite the rule of the company requiring it. There seems to have been such a rule but both Brill (R., p. 303, Q36) and Daniels (R., p. 220, XQ120) seem at times also to have been guilty of departures from it. Petitioner states Weiss claimed a special dispensation for himself. *This is not so.* He said he had been given no definite rules, that

it was his understanding that he was to use his discretion as to what was to be recorded and when, and that he did not record the early experiments with DPG in December, 1918, and January, 1919, because he regarded them as incomplete. As soon as he achieved success, it is to be noted, the results were recorded beginning with the experiment of February 10, 1919. In view of the great difference in speed between DPG and the accelerators to which he was accustomed it is incredible that this first recorded success was not preceded by some unrecorded experimenting.

In the next breath (Pet. br., p. 47), the petitioner seeks to repudiate the X-book itself despite his earlier complaint that Weiss did not use it to record all his work. The complaint is that at the trial only Weiss interpreted these entries. Who but Weiss should? Petitioner seems to mistake completely the purpose of the X-book exhibits. They are in corroboration of Weiss' oral testimony. The X-book entries were made years before the application for the patent in suit and Weiss has had no opportunity since to alter them. The existence of these X-book entries under these circumstances constitutes a perfect documentary corroboration of Weiss' testimony in reference to the matters to which the entries relate.

Complaint is made (Pet. br., p. 49) that one of Weiss' DPG entries, X-2006G, is undated but there are dozens of undated entries in the X-book pages that have been put in as exhibits in this case. See, for example, R., pages 724, 726, 727, 728, 729, 730, 731, 732, 734, *et al.* Almost every page from the X-book has one or more.

The next complaint is that Weiss tried to link X-2010H (right hand) with X-2010H (left hand) to be found at page 736 of the record. The right hand entry is dated "9/29/19." The left hand entry is dated "Sept. 6-19" and is the entry we discussed in connection with the attack on Nellen's testimony at pages 39-41 of this brief. Reference to that will show that Nellen's testimony, taken with this X-2010H left hand entry, was strongly corroborative of Weiss' testimony to his

work on DPG in the summer of 1919 prior to the Kratz lecture on September 6 of that year. By the same token it increased Weiss' credibility.

If the X-2010H right hand entry is inspected the court will see that the formula used is the same as that in the X-2010H left hand entry with the exception of the accelerator used which in the right hand entry was "Diffendoe." This was the factory code name at Republic for DPG (R., pp. 208, and 117.) In other words the formula was the formula which Nellen testified he gave to Weiss to use for testing DPG. The entry corroborates Nellen in his recollection by showing that Weiss *did* use the formula *which the left hand entry shows he must have gotten on September 6, 1919, or earlier* for the purpose for which Nellen said it was obtained. This is the reason the two entries should be tied together. The court will certainly agree that witnesses whose testimony dovetails thus perfectly cannot be easily impeached.

Nellen's testimony on the above matter together with its documentary corroboration also shows that on September 6 or earlier Weiss had or expected to have DPG for making tests. This should be considered in relation to Weiss' testimony that he made DPG in August, 1919, which petitioner complains of as uncorroborated. (Pet. br., p. 50). Respondent agrees with petitioner that it would be hard for Weiss ordinarily to be sure five years afterward whether this DPG was made in August or September but the X-book entries, coupled with Nellen's testimony, make it seem at least highly probable that Weiss' recollection was accurate.

As to the "inner-tube-splicing-cement" incident (pet. br., p. 51) this is the same experiment discussed *supra* at pages 42 and 43 in connection with the attack on the witness, Daniels, and recorded in the Republic X-book at page 1777 (R., p. 724). The assertion is made that Weiss and Daniels are in conflict as to the date of this experiment and that Daniels is "obviously" correct—that is, that Weiss plainly disregarded the truth in his testimony. As the respondent has al-

ready shown *supra*, there is nothing "obvious" about the date from the record of this experiment—in fact, it is impossible from the X-book entry to determine whether it was Daniels or Weiss that was in error. Respondent places no reliance on this test and it is therefore unnecessary to fix its date; but respondent does wish to insist that there is no basis for the imputation of petitioner that Weiss disregarded the truth in his testimony.

At page 52 of his brief petitioner makes a very extended complaint as to Weiss' testimony regarding the date of certain undated tests appearing on the six columns of page X-2066 of the X-book (R., p. 765). The first complaint is that Weiss testified that these experiments were made in the summer of 1919 when the X-book pages next preceding X-2066 contain experiments dated September, October, November and December 1919 and those next following contain experiments dated in 1920. Respondent has already had occasion to point out in meeting the attack on Daniels at page 43, *supra* the want of any correlation between the chronological sequence of the entries in the X-book and the numerical sequence of the pages thereof. At that point several examples of this want of correlation were given. The same examples are pertinent here.

Petitioner proceeds:

> "Furthermore, when Weiss was on the witness stand in the *National* suit and told about his two tests with shoddy compounds and the one test with the changed date, he was asked if the X-book contained any other record of a test with DPG made prior to September 2-6, 1919, and was instructed to go through the X-book in search of any such test, and at no time did he ever suggest that these entries on page X-2066 or any others in the X-book, except for the three above identified, were made prior to September 2-6, 1919 (Vol. 1, pp. 170-1, Q398-403, and Nat. Rec., pp. 280-1, Q428-30)."

The fact is the reference to the *National* record shows that counsel for the defendant in that case, in cross-examining

Weiss, made the "instruction" referred to, telling Weiss to go through the X-books during the noon recess and to call counsel's attention to it after the recess if he found any other experiments antedating the Kratz paper. After the noon recess counsel for the defendant cross-examined Weiss on other matters and never returned to the matter of the early experiments. Counsel for respondent submits that the burden of cross-examination can not thus be shifted to the witness and afterwards made the basis of an attack on the witness' credibility.

The testimony of Haring, the hand-writing expert, to which petitioner also refers on page 52 of its brief, is commented on *infra* page 51 in the discussion of the disputed experiment of February 10, 1919.

At pages 53 and 54 of its brief, petitioner quotes from what it refers to as Exhibits D and VV in the present case. Neither is printed in the present record and counsel for respondent has neither exhibit before him as he writes; but the portion of these exhibits quoted by petitioner seems a sufficient answer in itself. The contention is that Weiss should not be believed because he was not believed in an interference proceeding in the patent office. The quotation shows that the Examiner denied credence to the testimony of Weiss because he sought to "intimidate" witnesses on the other side by threat of uncomfortable cross-examination if the witnesses made certain statements which Weiss knew to be false. The respondent would like to ask since when a threat to cross-examine to bring out the truth has constituted intimidation of a witness. The ruling of the Examiner was plainly error.

The same sort of an attack is made on respondent's witness Woodward. Respondent suggests that this Court turn to pages 646 and 647 of the record and see the attitude of the trial court on this attack on Woodward. It is submitted that the trial court was right. The facts actually were harmless as the court surmised.

The Disputed Test of February 10, 1919.

With reference to this test, the petitioner maintains that the figure "2", indicating February, was built over a "9", indicating September. He says Weiss admitted that the figure had been changed and that he had changed it. (Pet. br., p. 47). As a matter of fact, Weiss said it looked as if it had been changed and that *probably* he had written a "1" first, indicating January, as one sometimes inadvertently will in early February, and that *probably* he had then changed it. There are instances of such changes elsewhere in the X-book. See, for example, X-2045A. (R., p. 755). Weiss did not pretend to any recollection of the matter. (Rec., p. 153.) He was not so ready to impute dishonesty to the petitioner as petitioner has been to impute such conduct to Weiss. The alleged change, of course, makes the difference betwen an experiment antedating and one postdating the Kratz lecture of September 6, 1919.

The X-book page is 2034, column E. (R., p. 748). An enlargement of the doubtful figures appears as plaintiff's Exhibit 10 (R., p. 749). The petitioner introduced one Haring, a handwriting expert, who purported to describe in detail exactly how the alteration was made, even to the angle at which the pen was held and the manner in which the nibs were spread (R., pp. 449, 450). His testimony is commended to the Court for what it is worth. This is indeed an age of experts!

This expert likewise presented defendant's Exhibits AA, BB and CC (R., pp. 966-968) in which he had painted out with Chinese white all that was necessary to make what was left look like a nine (R., p. 451). These pictures are the best condemnation of this expert's testimony.

The court should bear in mind that Weiss never saw the X-book from March, 1920, until it was produced in the National Aniline trial in 1923. Prior to March, 1920, he had no motive for altering the date. He had not been advised

that his discovery was patentable, and in fact, had been told that it was not. No thought of building up a record for future controversy was in his mind. After he had a motive for alteration, he was without opportunity therefor.

Moreover, there were plenty of places for Weiss to have inserted early dates on DPG tests which are undated in the X-book, if he had had any desire to falsify his records. Page 2066 contains several undated DPG tests. *It would be astonishing stupidity to alter the date of one test when blank tests could have been dated, if there had been any base motive at work.*

It is important to notice the composition of the compound used in the disputed test—50 parts pure rubber (smoked sheets), 43 zinc oxide, 4 sulphur, 2 magnesia, and 1 DPG. Throughout Weiss' records in the X-book, as a careful examination will disclose, new accelerators were regularly tested first on a rubber compound of this recipe. Weiss testified that the first thing he did with any accelerator was to test it on the rubber. (R., p. 173.) Thereafter factory compounds with shoddy were tried out. So here, the shoddy tests of February 21, and March 4 were preceded by the rubber test of February 10th, 1919.

At page 48 of its brief, petitioner seeks to discredit this test by the statement that although in the present case Weiss stated that this test on pure gum stock (X-2034 E) was the first he made, in the *National* case he testified at page 229 of the record therein that "his 'first thought' after he had made some DPG was to see how it would work with shoddy." But plainly this was a mere statement by Weiss of his interest in shoddy at this time. It is no statement of the order of the tests. On the very next page of the *National* record he states definitely that he had made a recorded test with a test formula that was earlier than the first shoddy test—that is, the test of February 10, 1919. There is no inconsistency in Weiss' testimony in the two cases that respondent can discern.

Careful examination of the Republic X-book shows that during the period of Weiss' employment up to and including the date of the Kratz lecture in Philadelphia, he investigated the properties of twelve new substances not in use at Republic as accelerators for the vulcanization of rubber, and that in every case his first test was in the standard accelerator test compound of

Rubber	50
Zinc	43
Sulfur	4
Magnesia	2
Accelerator	1

This is the formula of the disputed test. The other initial tests of new accelerators with this formula are recorded as follows:

Page	*Date*	*Accelerator*
2031-E	6/17/18	T. P. G.
2031-C	6/ 7/18	Anhydro formal anilide
2034	10/22/18	Phenylthiourea
2034-E	2/10/19	D. P. G.
2031-A	6/ 7/18	Frazars accelerator
2031-B	6/ 7/18	Di cyandiamid
2031-D	6/ 7/18	P-diamido diphenyl methane
2031-F	6/ 7/18	P-toluene sulfanide
2034-B	10/22/18	Anhydro formal anilide
2034-G	.....	Distilled thorax
2034-H	.....	Virginia bark
2039-G	.....	Phenyl urea

These entries would seem to furnish ample corroboration of Weiss' testimony that it was his habit to test all potential accelerators in this compound before determining their value in other types of compounds. In the case of the disputed test of February 10th there was no reason shown for a departure

from his usual practice and it is reasonable, therefore, to believe that the date shown in the X-book is the true date of the test.

(e) RECAPITULATION.

Respondent has gone fully into the attack on the credibility of its witnesses, not because it deems it essential that they be believed as to the matters as to which petitioner has attacked their testimony; for the undisputed tests of February 21, 1919 and March 4, 1919 establish a date for the Weiss invention, sufficiently early for the purposes of this case. Respondent has met squarely the attack on the credibility of its witnesses because respondent has desired to meet petitioner on petitioner's own ground. Respondent submits that every attack has been met. There is no reason why the testimony of respondent's witnesses should not be accepted in full.

Petitioner would have this Court believe respondent's case is built on perjured testimony and that that fact is obvious. A sufficient answer is that Judge Buffington and Judge Davis of the Third Circuit and Judge Manton and the late Judge Mayer of the Second Circuit have all been convinced of the merits of respondent's case. Judge Buffington, though resting the decision of the Third Circuit on the ground that the Kratz paper contained no disclosure of the patent in suit, went out of his way to say that he and Judge Davis, for the court, had reached the conclusion that the true date of Weiss' disputed experiment, X-2034E, was, as recorded in the X-book, February 10, 1919.

The petitioner, of course, emphasizes the fact that the trial judge in this case saw the respondent's witnesses and refused in part to believe them; but it is submitted that the foregoing analysis shows the trial judge too clearly wrong to permit of this Court's reinstating his findings. Moreover, it must not be forgotten that another trial judge, Judge Manton of

the Second Circuit, saw the same witnesses in the *National Aniline* trial, and *did* believe them. See Appendix.

It is submitted that the Court of Appeals herein was right and that plaintiff is entitled to date his invention as early as February 10, 1919 for its reduction to practice, and, in view of his diligence in the face of adverse conditions subsequent to his first practical conception and its disclosure in March, 1918, he is entitled to the benefit of that date, also, if that be necessary.

It follows that Weiss is entitled to the status of first, sole, true and original inventor as of one of these dates unless barred by the defenses presently to be discussed.

POINT II.

None of the defenses based on incidents prior to the Kratz paper of September 6, 1919, defeat the patent.

[NOTE: *To a proper understanding of what follows under this point prior perusal of pages 1-9 of this brief is necessary.*]

The petitioner contends that certain early work of Kratz is sufficient to defeat the patent, even if Weiss was able to date his invention in February-March, 1919. This work of Kratz properly belongs in three groups: (a) laboratory tests at Norwalk in the fall of 1916; (b) alleged actual acceleration with DPG of a mix for 300 tubes at the Falls Rubber Company in 1917; and (c) alleged laboratory work at the Falls Company in 1918. These will be considered in chronological order. In addition, two other defenses are advanced by the defendant: the so-called Baldwin experiment, appearing at page X-2005 Blank of the X-book, dated February 22, 1917, and the disclosures in the King and Twiss papers. These will be separately considered below under subheads (d) and (e). The paper of Du Bosc petitioner dis-

cusses solely as a "special matter" pertinent to the broader claims of the Weiss patent. Discussion of that paper is therefore to be found in this brief under Point IV (a) *infra*.

(a) KRATZ' WORK AT NORWALK.

From April 1, 1914, until April 1, 1917, Kratz was in the employ of the Norwalk Rubber & Tire Company at Norwalk, Connecticut. It is not disputed that in 1916 he carried on some experiments designed to ascertain the comparative strength of various vulcanization accelerators when compared with sulphocarbanilide. These tests were recorded in the records of the Norwalk Company (R., pp. 952-956).

It is worth while to state in detail what was done. Using a compound of 200 parts rubber, 200 zinc oxide, 10 sulphur and 6 sulphocarbanilide (accelerator) cured for 60 minutes, at 50 pounds as a base, the "idea" as stated in the experimental record was "to determine the amount of the other substances necessary to be used in order to give same cure in the same time". The attainment of "cure" was to be determined by the observation of physical properties in the product, not by chemical analysis.

It is enlightening on the issue of anticipation to note the method of observation. By Kratz' own admission, the so-called "thumb and tooth" method was used (R., p. 404). That is, the learned doctor pulled and bit each slab of rubber to determine whether its cure was perfect or not. He did nothing more. No attempt to *measure* the physical properties of the cured slabs was made. In fact, Kratz frankly stated that he was not completely familiar with the more exact methods of testing (R., p. 404) and he could not say for certain whether the Norwalk plant in 1916 had even a single machine for making such tests (R., p. 404).

In contrast with the methods of Kratz are those of Weiss. In all of the experiments upon which respondent relied under Point I of this brief to establish the date of the Weiss invention, Weiss at the very least, measured accurately the

"stretch", "strength" and "set" of the product. In contrast with Kratz, Weiss was interested in the *useful qualities of the product* as well as the speed of the accelerator and was seeking, as he said in his patent application, "to *improve rubber compounds so that the finished product shall be of superior quality* and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for that purpose."

As one among a group of other accelerators, DPG was tried out by Kratz in quantities, varying from three parts to five parts (R., pp. 351-352, 952). The results for the various accelerators were summarized on a separate sheet (R., p. 953). On the basis of 3% sulphocarbanilide *on the rubber* as a base (that is, 6 parts to 200), Kratz concluded that it would take 3.5% of aniline, 1.75% of TPG and .25% of DPG to accomplish the *same* cure in the *same* time. *Thus, on the basis of sameness of cure determined by his biting and pulling, Dr. Kratz assumed to carry his results* out to the hundredth part of 1%!

It must be clear to the Court, apart from the question of the accuracy of Dr. Kratz' determinations, that the percentages arrived at in the Norwalk investigation showed *absolutely nothing* as to the temperature at which curing starts with DPG, or with any of the other accelerators; *nothing* as to the protection they afford against overcuring; *nothing* as to the wearing and aging qualities of the product to be obtained by their use; and *nothing* as to the comparative physical properties of the rubber cured with the various accelerators, even at the moment of the completion of the cure. *In a word, the investigation showed absolutely nothing as to the practical utility of the substances investigated.*

Perhaps no further comment is necessary to show the impossibility of the Norwalk investigation as an anticipation of Weiss' invention. It may, however, be added that Kratz informed his superior, Russell, of his work (R., p. 355) and

that, though Russell remained at Norwalk, the Norwalk Company saw no advantage in using DPG as a result of these tests. Russell so testified (R., p. 1023). Neither did they make any practical application of any other information contained in Kratz' summary.

Kratz explains non-use by claiming inability to produce DPG in sufficient quantity at sufficiently low cost, but he was an experienced chemist and if he had seen the need for such production, no doubt he would have attempted to supply it. His Norwalk method (R., p. 954) and Weiss' process patent (R., opposite p. 1002) are very similar. In fact, the only difference is in the form of ammonia used. The only inference that can be drawn from his behavior and from that of the Norwalk Company is that nothing was discovered as to the practical utility of DPG in the rubber art.

The experiments were in secret and secret experiments do not defeat subsequent patents. As far back as the leading case of *Bedford* v. *Hunt*, 1 Mason, 302, 305, Mr. Justice Story said:

> "The intent of the statute was to guard against defeating patents by the setting up of a prior invention which had never been reduced to practice. If it were the mere speculation of a philosopher or a mechanician, which had never been tried by the test of experience, and never put into actual operation by him, the law would not deprive a subsequent inventor, who had employed his labors and his talents in putting it into practice of the reward due to his ingenuity and enterprise."

Again in *Agawam Co.* v. *Jordan*, 7 Wall., 583, 602, Mr. Justice Clifford states the principle:

> "The settled rule of law is that whoever first perfects a machine is entitled to a patent, and is the real inventor, although others may have previously had the idea, and made some experiments towards putting it into practice."

Very pertinent is the language of this Court in *Tilghman* v. *Proctor*, 102 U. S. 707, 711:

> "The accidental effects produced in Daniel's water barometer and in Walther's process for purifying fats and oils preparatory to soap-making, are of the same character. They revealed no process for the manufacture of fat acids. If the acids were accidentally and unwittingly produced, whilst the operators were in pursuit of other and different results, without exciting attention and without its even being known what was done or how it had been done, it would be absurd to say that this was an anticipation of Tilghman's discovery."

The sum of the Kratz investigation of DPG at Norwalk was that, using the same formula, and temperature, 0.25% DPG on the rubber made a slab, that, *when pinched and bitten by him, felt* the same *to him* as a slab made with 3% of sulphocarbanilide. In *Diamond Meter Co.* v. *Westinghouse Electric & Mfg. Co.*, 152 Fed. 704, 714 (7th C. C. A.) Judge Baker said:

> "Patents are granted for advances in the useful arts, not for increments of knowledge."

Possibly this was an "increment of knowledge", but, even this seems doubtful. As science, finding values to the hundredth part of 1% is absurd where the values are bottomed upon mere biting and pulling by the experimenter.

As an anticipation of Weiss' patent, it was clearly deficient in substance. If anything approaching Weiss' DPG rubber was produced it was "accidental * * *, not intended and not appreciated" and did "not constitute anticipation." *Eibel Co.* v. *Paper Co.*, 261 U. S. 45, 46. It must "be relegated to the class of unsuccessful and abandoned experiments, which, as * * * repeatedly held, do not affect the validity of a subsequent patent". *Deering* v. *Winona Harvester Works*, 155 U. S., 286, 301.

(b) THE ALLEGED MANUFACTURE OF THREE HUNDRED INNER TUBES IN 1917.

Dr. Kratz testified that some time in September of 1917, while he was Chief Chemist for the Falls Rubber Company, two batches of rubber compound from which 300 gray automobile inner tubes were made, were accelerated by him with DPG (R., pp. 362 *et seq.*) The 300 tubes, he said, were part of an order of 1,000 tubes which were actually delivered to the Rubber City Clearing House. Shipping documents covering a shipment of 1,000 tubes to such consignee were introduced in evidence as defendant's Exhibit T. (R., p. 958.) There is nothing in these documents to corroborate Kratz' oral statement that he used DPG as the accelerator. Petitioner endeavored to corroborate this statement by introducing his Exhibit S (R., p. 957), purporting to be a laboratory record of experiments carried on in preparation of a tube stock that would meet the requirements of the 1,000 tube order referred to. (R., p. 365.) But that record was dated during the month before these tubes were shipped and is no proof that these tubes were made on that recipe.

As explained by Kratz, defendant's Exhibit S shows three compounds in parallel columns, each containing a recipe for a tube stock. The right hand column marked 63 Mod., otherwise known in the factory as T-8, was said to have been the one actually used. Even if it were established that this formula was actually used, it would not settle what accelerator was used with the formula. If the Court will turn to the Exhibit, it will see that there is a blank space opposite "Mannose R"—a code name for some accelerator in use at Falls the identity of which Kratz refused to divulge. In the margin this notation appears

"?
Lago P—2.0
M or Diphig—0.2"

Kratz explained this as indicating how much DPG it would be necessary for him to use if he accelerated the compound T-8 with DPG. Kratz testified that "Lago P" and Diphig were factory code names for "thio" and DPG and petitioner says he testified that "M." was MPG, but this last respondent has been unable to verify. Giving petitioner the benefit of every doubt on this notation it leaves it an open question whether "M. or Diphig" was used. Kratz himself so admitted (R., p. 392):

> "Q. Exactly. Now what connects this order with the substitution you stated this morning in No. 63? A. That question isn't clear.
>
> "Q. You said this morning that you substituted diphenylguanidine in formula 63 for mannose R. I now ask what connects that substitution, if and when you made it, with this Rubber City Clearing House order of September 4th, 1917? A. Well, as explained this morning, I knew the relative activity of mannose R, lagos P, and diphenlyguanidine. To me any of those three substances was interchangeable in the quantity shown, but I wanted to try the diphenylguanidine in practice. That was the reason that substitution was made.
>
> "Q. And that is the substitution that you told no one about, isn't it? A. Yes, sir. I had no one to tell.
>
> "Q. What enables you to say that you used the .2 parts of diphig instead of M. or monophenylguanidine? A. Well, I have never been able to have any great quantity of monophenylguanidine. In fact, it is, as I remember it, more difficult to prepare, and get pure.
>
> "Q. Is there anything in this entry referring to lagos P. and M. or diphig, which shows which of these three materials was actually substituted? A. No, I wouldn't think so.
>
> "Q. That is, you can't tell from this entry on the sheet which was actually substituted? A. No. These are my personal notations there—you couldn't."

Kratz testified that he had sufficient DPG to accelerate the first two batches for these tubes and that thereafter he was obliged to use other factory accelerators to complete the

order; that at his direction the compound man who prepared the batch put in less magnesia than the formula called for and that thereafter Kratz himself poured DPG into the mixture in the form of a white powder, not telling anyone else in the establishment what he was doing (R., pp. 366, 372). At page 372 of the record he was asked:

> "What I am getting at is this, who if anybody knew you had put DPG into that batch? A. Not a soul, not a soul knew it. They simply knew that I was putting some white substance in there."

There was no such testimony as the above by Kratz or anyone else in the *National Aniline* case.

Kratz further testified that the DPG batches thereafter went through the usual factory process but were differently tagged (with red tags) which followed the compound until the finished tubes were reached when samples were brought back to him for inspection (R., pp. 400, 401).

Judge Hough in the *National Aniline* case found that Kratz made the tubes with DPG and sold them. Under cross examination in the instant case Kratz's making and selling the tubes has dwindled to the act of sifting into a rubber "mix" a white powder whose identity was known only to him. It can hardly be supposed that Judge Hough would have made the same finding on the Kratz testimony in the instant case.

The respondent introduced two witnesses, Shaw and Hoffman, who were employees at the Falls plant at the time of the alleged manufacture of these 300 tubes. Shaw was the compound man who weighed the ingredients and prepared the mixture which went into the milling machine where it was mixed sufficiently to prepare it for the curing process. He was given a copy of each recipe by Kratz and was in the habit of keeping copies of familiar compounds. He produced a copy of T-8 as he had used it in the Falls factory, as plaintiff's Exhibit No. 13 (R., p. 772.) *It contains no mention of*

DPG. He never saw Kratz put anything into a batch on the mill (R., p. 583.) He further testified that he had never seen any red tags used in the Falls factory (R., p. 585.)

Hoffman was a milling man who operated three mills on the first floor in the Falls plant in 1917 and it was at one of these three mills that Kratz claims to have used the DPG. He testified that he had never seen Kratz put powders in the compounds which were being mixed, nor had he ever seen any red tags on rubber stocks going through the mill room (R., p. 599).

Neither Shaw nor Hoffman testified in the *National Aniline* case; nor was any testimony offered to rebut Kratz on this point in that trial.

In an effort to show the successful character of this acceleration test, Kratz testified that DPG was used thereafter in the Falls factory as soon as it could be obtained on a commercial scale (R., p. 406.) When asked when that use commenced, he replied that he couldn't say.

Petitioner explains the non-use again by Kratz' inability to make DPG. Respondent has already shown the emptiness of this explanation. *Supra*, page 58.

This whole defense manifestly rests on nothing but the oral testimony of Dr. Kratz. Apart from any consideration of his credibility it is enough to say that it falls short of what has been repeatedly held essential in proving prior use to defeat a patent. The shipping documents do not corroborate the testimony, and the laboratory memoranda are completely equivocal and ambiguous. *Furthermore, the laboratory record is not connected in any way with the actual making of the tubes.* He himself admitted that no one else in the plant knew what he was doing, thus conceding the secret nature of the work. The incident is an isolated, unexplained, and unexplainable departure from factory routine. It was followed up by no further practical applications, though had Kratz desired to use DPG further, he could have done so; for his Norwalk recipe for its preparation (R., p. 954) shows that he knew how to make it.

The whole proceeding smacks of improbability. It is so out of the ordinary and admitted factory routine, so devoid of purpose, so wholly inexplicable. It fails not only for want of corroboration but also for inherent incredibility.

As stated by this Court in *Deering* v. *Winona Harvester Works*, 155 U. S. 286, 300, 301:

> "Taking this evidence together, it falls far short of establishing an anticipation with that certainty which the law requires. As we have had occasion before to observe, oral testimony, unsupported by patents or exhibits, tending to show prior use of a device regularly patented is, in the nature of the case, open to grave suspicion.
>
> • • • • • • • • • •
>
> "This case is an apt illustration of the wisdom of the rule requiring such anticipations to be proven by evidence so cogent as to leave no reasonable doubt in the mind of the court, that the transaction occurred substantially as stated."

The same rule was stated in *Pyrene Manufacturing Co.* v. *Boyce*, 292 Fed. 480, 485:

> "It is well settled that evidence of prior use must be clear and satisfactory and in its consideration every reasonable doubt should be resolved against the one raising the question. Eibel Process Co. v. Minnesota & Ontario Paper Co., 261 U. S. 45, 43 Sup. Ct. 322, 67 L. Ed.—; Barbed Wire Patent Case, 143 U. S. 275, 284, 12 Sup. Ct., 450, 36 L. Ed. 161; Coffin v. Ogden, 85 U. S. (18 Wall.) 120, 124, 21 L. Ed. 821."

Secret uses are infected with incredibility. Still more so if isolated. In *Richards* v. *Burkholder*, C. D. 1907, 563, 565, 29 App. D. C. 485, was said:

> "If there be concealment or suppression of the invention, the field lies open to be occupied by a more diligent, though later inventor, who, when he has not only put the invention into public use but has also obtained a

> patent for it, cannot be divested of his right to hold the field except upon proof beyond a reasonable doubt that the earlier and more negligent inventor has not gone back to an abandoned device or a device suppressed or concealed in order to establish a prior right."

The remarks of this Court in *Washburn & Moen Mfg. Co.* v. *Beat 'Em All Barbed Wire Co.*, 143 U. S. 275, are very pertinent:

> "We have now to deal with certain unpatented devices, claimed to be complete anticipations of this patent, the existence and use of which are proven only by oral testimony. In view of the unsatisfactory character of such testimony, arising from the forgetfulness of witnesses, their liability to mistakes, their proneness to recollect things as the party calling them would have them recollect them, aside from the temptation to actual perjury, courts have not only imposed upon defendants the burden of proving such devices, but have required that the proof shall be clear, satisfactory, and beyond a reasonable doubt. Witnesses whose memories are prodded by the eagerness of interested parties to elicit testimony favorable to themselves are not usually to be depended upon for accurate information. The very fact, which courts as well as the public have not failed to recognize, that almost every important patent, from the cotton gin of Whitney to the one under consideration, has been attacked by the testimony of witnesses who imagined they had made similar discoveries long before the patentee had claimed to have invented his device, has tended to throw a certain amount of discredit upon all that class of evidence, and to demand that it be subjected to the closest scrutiny. Indeed, the frequency with which testimony is tortured, or fabricated outright, to build up the defense of a prior use of the thing patented, goes far to justify the popular impression that the inventor may be treated as the lawful prey of the infringer."

The policy behind the rule requiring indubitable proof of public use is obvious. Patent laws exist to promote inven-

tive research by rewarding it. If an inventor were liable to be deprived of the fruits of his work by the lone testimony of a rival as to that rival's secret doings, the whole purpose of the patent law would be frustrated. Yet such is the nature of this defense urged by petitioner.

(c) THE SUBSEQUENT EXPERIMENTAL WORK AT THE FALLS COMPANY.

An effort was made to give the alleged prior work of Kratz an appearance of continuity by introducing his testimony that in 1918, at the Falls Company, he carried on further experiments in the use of DPG as an accelerator, and that it was the result of these experiments that he reported in his paper read at Philadelphia on September 6, 1919. The only testimony along this line is at page 374 of the Record, where, in referring to certain tables in his paper, he said that the work reported thereby had practically all been done at the Falls Company and that it extended over a considerable period of time in 1918.

No records of any sort were introduced to corroborate this testimony; nor did his co-workers, Flower and Coolidge, corroborate him. Indeed, there is no evidence whatsoever, beyond the statement of Kratz, that these experiments were ever carried on.

The absence of documentary corroboration is noteworthy, for petitioner is very insistent that Kratz is a chemist who keeps exact records of all his experimental work. Indeed, this seems to be Kratz' own position (R., p. 342).

The most significant fact, however, about this testimony is the fact that the table, asserted to embody the results of these experiments, contains internal evidence that the experiments never were carried on in 1918 as stated.

The tests were made, it is asserted, with a standard testing formula containing only raw rubber, sulphur and an accelerator, and were made to check the Norwalk tests of 1916 which had been made with a standard testing formula con-

taining, in addition to the constituents above mentioned, zinc oxide. The results of the Falls' tests are said to be embodied in Table 1 of the paper Kratz read at Philadelphia in 1919 (R., pp. 374-375; Pet. br., p. 73). At page 73 of his brief, petitioner is pleased to make a comparison of the results stated in the paper with the results shown to have been obtained at Norwalk in 1916, forming one of the exhibits in this case (R., pp. 952 *et seq.*). That table is reproduced below:

	Activities Given in Table in Paper	Figures in Paper Multiplied by 3.5	Norwalk Tests
Aniline	1.00	3.5	3.5
Urea	0.250	0.875	0.33
Thiourea	0.300	1.050	1.0
Monophenylthiourea	0.450	1.575	1.5
Diphenylthiourea	0.850	2.975	3.0
Monophenylguanidine	0.075	0.262	0.25
Diphenylguanidine	0.075	0.262	0.25
Triphenylguanidine	0.500	1.750	1.75

The results, it will be observed, are almost identical with the exception of urea.

This is true of the tests with diphenylthiourea. Yet in the paper published by Kratz February 25, 1921 (R., p. 792), he says:

> "It has for some time been generally recognized that although aniline is effective as an accelerator in the absence of zinc oxide, *diphenylthiourea functions but mildly in the absence of, and strongly in the presence of this substance.* * * *
>
> "Our former experiments, however, were confined to the determination of sulphur co-efficients at one cure only. In the present instance, we desired to compare the relative effects of aniline and diphenylthiourea over a series of cures, and to effect this comparison both by means of the sulphur co-efficients and the physical properties of the various mixtures and cures. Further, it

was desired to compare mixtures which contained zinc oxide as well as the rubber sulphur mixtures previously employed. * * *

"Summarizing these results briefly, we found that, *in a rubber-sulphur mixture, the accelerating effect of aniline is considerably greater than that of diphenylthiourea,* when judged either by sulphur coefficients or on the basis of the physical properties of the vulcanized mixtures. *In mixtures which contained zinc oxide, however, the reverse was found to be true, and diphenylthiourea was more active than aniline when judged by either of the above criteria.* * * *" (Italics ours.)

Manifestly, if, as Kratz himself says, there is such a difference in the behavior of diphenylthiourea as an accelerator in the presence of and in the absence of zinc oxide—and this *is* a fact—then Kratz surely would have noticed this difference if he actually made the test at Falls in 1918 as he testified, and surely he would have recorded this very great difference in the statement of his results in the paper read before the American Chemical Society in September, 1919. But on the petitioner's own showing, the results stated in the Philadelphia paper, supposed to have been obtained without zinc oxide, are practically identical with the results gotten in Norwalk in 1916, with zinc oxide as a part of the formula. The conclusion, therefore, cannot be escaped that no tests were ever made at Falls in 1918 with diphenylthiourea, as testified. If Kratz falsified as to the making of the diphenylthiourea tests what reason is there to believe him as to the other substances in his table, including DPG? The conclusion seems justified that at least part of the table in the Philadelphia paper was based on recollections of the work at Norwalk and not on new work at Falls. There is nothing to show that the DPG work was not among the recollected part.

None of the courts below in either this or the *National Aniline* case, have relied on these Falls' tests of 1918. Only the District Judge in the present case even found that they

had occurred. It is obvious that they do not satisfy the requirements of a prior use and no inference of continued activity with DPG can fairly be bottomed upon them since the evidence clearly does not justify the finding of their having been made.

One further point, but a point of great importance. The testimony at page 374 of the Record is that they occurred in 1918. There is nothing to fix their date prior to March of that year—which, as has already been shown, is the date of Weiss' conception of his invention.

As to the substance of these tests, it was the same as the paper of September 6, 1919, in Table I of which they were embodied. It will be shown *infra*, in Point III that this paper was no such disclosure as would invalidate the Weiss patent. By the same token, the tests themselves would not have been either, even if they had occurred.

(d) THE ALLEGED BALDWIN ANTICIPATION.

The petitioner contends that Weiss got his idea of using DPG as an accelerator from the work of the witness, Baldwin, his predecessor at the Republic factory. Only one entry in the X-Book, X-2005, first column, marked "(X-2004?)" was adduced in support of this contention, and that was marked "N. G." Truly inspiring!

There is really not a shadow of doubt that that single entry is, in part, a fabrication. This was the opinion of Judge Manton in the *National Aniline* case (Appendix, p. 110), and if this Court, while reading what follows, will turn to the photostat of that entry to be found at page 73[illegible] of the present record, the respondent is confident that he can show this Court that Judge Manton was correct. It may be added that neither the Second Circuit in the *National Aniline* case nor the district judge in the present case relied on the alleged Baldwin test in reaching their decisions.

Baldwin testified that the entry was his and that from the record he could *say* that he had conducted the experiment

(R., p. 314). *He did not testify that he remembered making it*, and the entry apparently recalled to his mind none of the details of the experiment. He was unable to say in what respect the experiment was "N. G.", or whence had come the DPG used in it. He was, however, ready enough to speculate on both questions (R., pp. 317-328). Petitioner says that DPG could have been and probably was obtained from the house of Eimer & Amend and cites in support Amend's testimony (R., pp. 291-2). The answer of Amend to question 16 on page 292 is a flat statement that Amend had no idea from whom he had received requests for DPG. There is nothing in his testimony corroborative of the Baldwin experiment or even its possibilty.

The witness Woodward testified that in May, 1922, he made a very careful examination of the X-Book and that he was especially seeking any entries having any connection with the use of DPG (R., p. 639). He distinctly recalled examining page X-2005 because he had occasion to compare the test referred to in column 8 of that page with 2006-G on the next page (R., p. 640). There was no entry of diphenylguanidine on the page at that time.

Thereafter, in June, 1922, he saw the X-Book again after having heard that it had been in New York, and discovered that page 2005 was missing. The next time he saw the X-Book was in December, 1922, in the New York office of the Republic Rubber Company, at which time page 2005 was back in place. On examination of the page, as to which his suspicions were naturally aroused, he saw the word "diphenylguanidine" printed as it now appears on the photostat (R., pp. 641-2).

Testimony similar to Woodward's was given by Carlton (R., pp. 628 and 622); Nellen (R., p. 637); Weiss (R., p. 592); and Vaill (R., p. 577)—all to the effect that in careful searches through the X-Book on various occasions there had been no entry of "diphenylguanidine" on the page in question prior to the controversy over this patent.

Petitioner says (Pet. br. p. 95): "Baldwin is corroborated * * * by the witnesses, Brill and Clark." The actual testimony was as follows: Petitioner's counsel at page 305 asked Brill: "Do you recall any work of Baldwin in connection with DPG?" Brill answered: "I do not." Nothing more: petitioner's counsel veered away from the subject of Baldwin and DPG.

The same is true with respect to the claimed corroboration by Clark as the following excerpt from his testimony shows (R., p. 442):

> *"Q. Are you able to state now, from your recollection, the names of definite substances that were tried in the course of that work? A. I cannot.*
>
> *"Q. You have no recollection of the specific test made with DPG? A. No, sir."*

He did say the testing of DPG would have been consistent with the search for new accelerators that he recalled was going forward at Republic at the time of the alleged Baldwin experiment. That is the extent of his "corroboration."

Apart from the foregoing considerations, there is the further suspicious fact that the total of the parts employed in this experiment appears to have been 101, whereas it is usual to have the parts total 100. It should be further noted that the total is expressed "101.00"—a rather curious fact when it is noted that none of the parts totalled carry the superfluous ciphers or contain any decimals. The ease with which "100" could have been changed to "101.00" is apparent. It is true that there are others of Baldwin's entries, the totals of which are 101; but of these but one is without the superfluous zeros, while, on the other hand, but one of his entries with a total of 100 has the superfluous zeros. The entry, "diphenylguanidine" has a "squeezed-in" look about it. The "diphenyl" part of it is much smaller than the "guanidine" part and the "i" and the "i" of the "guanidine" it should be noticed, definitely "dodge" the "D" of the "D. Phoidly" which appears in Wales' handwriting in the line below. Clearly, the "D. Phoidly" was there first.

Finally, Weiss testified that the first column looked to him as if it had originally been a test of a standard comparison formula without accelerator. The entry at the top refers to "X-2004C". Turning to X-2004C (that is, column C of page X-2004) to be found at page 730 of the Record, we find a Baldwin entry corresponding to Weiss' supposition—a formula without accelerator. (Zinc, that is, zinc oxide, is a filler, not an accelerator.) The entry on X-2004C apparently was abandoned as no results are recorded at the bottom of the column. The abandonment of X-2004C for X-2005 is perhaps to be accounted for by the fact that part of the printed form is missing from X-2004—that is, the words "8 sheets"—of which 50 parts were to be taken.

Finally, that Weiss' interpretation of this exhibit is the only tenable one is shown by the entry under "cure," near the bottom of the column. Turning back to the exhibit, this is seen to be "120/40," that is, 2 hours (120 minutes) at 40 pounds pressure. A cure of 2 hours at that pressure would be utterly ridiculous for a formula containing any accelerator at all as the other entries show.

There can, therefore, be no doubt that Judge Manton, who saw the witness Baldwin, was right in refusing to accept the evidence of this alleged experiment. But at best, it was "N. G." and not repeated—that is, abandoned and unsuccessful.

(e) THE PAPERS OF KING AND TWISS.

The papers of King and Twiss, two published articles on the general subject of rubber vulcanization, were introduced by the petitioner. One by King, in "Metallurgical and Commercial Engineering" for September, 1916, gives a list of organic accelerators known at that time. One sentence in that section reads, "Urea and such derivatives as guanidine are advised" (R., pp. 920, 922). This is the only reference in this article within miles of the patent in suit and

this reference is neither to DPG nor to any other di-substituted guanidine.

The other article referred to was by Twiss and contains one reference to aminoguanidine as follows:

> "I have also found that the unstable base aminoguanidine forms an excellent accelerator when applied in the form of its more stable bi-carbonate salt, whilst ammonium bi-carbonate is also very effective" (R., pp. 924, 928).

Aminoguanidine denotes the mono-substituted not the di-substituted compound. Neither of these papers was relied upon by the district court below, and they require no further discussion at this point. Neither of them mentions DPG or TPG. In view of the fact that there are thousands of compounds in the guanidine family, reference to that family was certainly not an anticipation of the idea of Weiss.

If the Court feels any doubt as to the irrelevancy of the above papers, the discussion under Point IV (a) and (b), *infra*, is referred to as demonstrating it more in detail.

POINT III.

The Kratz paper did not disclose the invention of the patent in suit.

(a) THE PAPER WAS IRRELEVANT AS SUBSEQUENT TO THE DATE OF WEISS' INVENTION.

Both the District Judge in the present case and Judge Hough in the *National Aniline* case treated the so-called Kratz paper as a complete disclosure of the subject-matter of the Weiss patent. Both courts, it is submitted, approached the case erroneously in first considering the Kratz paper, concluding that it told the whole story, and then examining the work of Weiss prior thereto. Such an approach puts the

paper into undue prominence. The first question is what did Weiss invent, and when? If the date of the invention was prior to September 6, 1919, the paper need not be considered at all. If it was after September 6, then, but only then, the paper becomes important.

The respondent has already shown that Weiss is entitled to date his invention as early as March, 1918, for its conception, and February-March, 1919, for its reduction to practice. Under either date, the Kratz paper is irrelevant as subsequent to the date of Weiss' invention; but even if the Kratz paper ante-dated Weiss' invention, it contained, as the following discussion will show, no such disclosure as will defeat the patent.

(b) THE COURT BELOW WAS CORRECT IN HOLDING THAT IT WAS UNNECESSARY TO CONSIDER THE TECHNICAL CONTENTS OF THE KRATZ PAPER IN VIEW OF THE CONSENSUS OF THE EXPERT TESTIMONY IN THIS CASE THAT IT DISCLOSED NOTHING AS TO THE PRACTICAL UTILITY OF DPG AS A VULCANIZATION ACCELERATOR.

The paper is Defendant's Exhibit E (R., p. 825). It is entitled "The Action of Certain Organic Accelerators in the Vulcanization of Rubber," and was published in April, 1920. Weiss' application was filed in November, 1921. As a printed publication, then, it is no statutory bar because within two years of the application. Judge Hough very properly so held in the *National Aniline* case and the petitioner in the present case so concedes in his brief at page 4 thereof.

The paper was orally delivered some day between September 2nd and 6th at the annual meeting of the rubber section of the American Chemical Society, and certain tables, including the so-called table No. 1 (discussed in connection with certain alleged tests by Kratz at Falls in 1918, pp. 66 *et seq.*, *supra*) were set forth on a blackboard. Among

those present at the lecture were Daniels (Weiss' superior), Williams of the Roessler & Hasslacher Company, Sanderson of the Fisk Rubber Company, Morse of the Atlantic Dye Stuff Company, Shepard of Firestone, and representative rubber chemists from the leaders in the industry. Kinsman of the Du Pont Company received a printed copy of the paper from Kratz in June, 1920 (R., p. 1010).

Before taking up the contents of the paper, it will be instructive to see what Kratz, at the time of reading the paper, thought that he was disclosing therein. It is true, as the petitioner contends, that the effect of the Kratz paper upon the Weiss patent, as a disclosure, cannot be controlled by Kratz's intent in publishing it; but Kratz's opinion, as the opinion of a trained chemist upon the import of the matters discussed in his paper is certainly pertinent for the consideration of this court in arriving at its own opinion as to what that paper disclosed. Keeping in mind, then, the essential claims of the patent—*the efficiency of DPG as an accelerator in the practical production of improved rubber products*—and keeping in mind, further, that Kratz was addressing his rivals in a highly competitive business, let us see what he intended to do and what he thought he was doing when he read the paper.

Almost at the outset of the lecture he said:

> "The activities of the substances from a practical standpoint were considered of secondary importance" (R., p. 826).

And as to the scope of the paper he said that the work recorded was in two groups—"Our subsequent and more extensive experiments" and "these preliminary tests". The subsequent experiments had nothing to do with DPG. The "preliminary tests were conducted solely to obtain information for guidance in subsequent experiments and as no sulphur estimations were made, *we do not feel warranted in drawing extensive conclusions from them.*" (Italics ours.) (R., p. 838.)

Kratz, at the date of the trial, held the same opinion as to the nature and scope of the matters discussed in his paper. He testified as follows:

> "A. We absolutely had no intention of giving any information which any other company or competitor could transpose directly for practical purposes. Our idea, however, did give enough information so that any reputable chemist would be guided by the information in the paper.
>
> "Q. Guided to the extent of being put on inquiry, to find out for himself anything you did not say—is that right? A. Guided to the extent of stimulating investigation along the same lines with which we were pioneering".
>
> "Q. And without telling him what to investigate? A. No, sir. We gave him two tables of what to investigate.
>
> "Q. But I mean, you did not tell him any specific substance to investigate? A. Well, we gave him two tables of substances, which we pointed out were excellent accelerators.
>
> "Q. And he could take his choice from any one of the substances mentioned in the two tables? A. Absolutely.
>
> "Q. And go on investigating for himself? A. Yes, sir, because there is no one accelerator of universal application or universal quality" (R., p. 409).

Petitioner criticizes the Circuit Court of Appeals severely for quoting and relying on this estimate which Kratz put upon his own work and for not placing its own estimate thereon. (Pet. br., p. 82.) But as has been already observed Kratz was an expert witness and it is submitted that the Court below rightly relied upon his opinion.

Petitioner contends that that part of the Kratz testimony already quoted has been falsified by tearing it from its context. The testimony in question was preceded by the following (R., p. 409):

> "Q. Were your experiments, as reported in your paper, made to show the relative utility of the substances tested, or to show the increase or variation in sulphur co-efficient? A. Well, that would be a very

> difficult question to answer. Any paper of this kind that would be published, you could not dwell too much on the utility of the different substances, or your superiors would feel as though you were giving away company secrets."

This shows Kratz knew he was on ground dangerous to the defense. In what followed the already quoted section Kratz merely sought to minimize the admissions made in the parts quoted. Respondent will be glad to have the Court read that section of the testimony *in toto* (R., pp. 409 *et seq.*).

There was no expert testimony contrary to this as petitioner seeks to induce the Court to believe. He says respondent's expert witness Whitby paid a fitting tribute to the Kratz paper. He probably refers to the following section of the testimony (R., p. 674):

> "Q. Does the paper by Mr. Kratz accurately state the relative activities of the substances mentioned? A. No.
>
> "Q. Please give your reasons. A. The figure given by Mr. Kratz for the relative activity of a variety of substances—I am especially referring to the figures in his Table 1—are grossly erroneous. The paper as a whole, considered as a whole, is inconsistent in itself. His results are inconsistent with the previous work he did at Norwalk. And furthermore, in so far as in later articles he reconsidered some of the matters dealt with in that April, 1920, paper, he entirely altered his position, and stated in effect that the previous conclusions were erroneous."

It is true that at a time when he had had only an abstract of the paper which omitted all figures as well as Kratz' theory, Whitby did write Kratz that so far as he could judge from the abstract of the paper, it was interesting and satisfactory; but in that letter *Whitby criticized Kratz for not testing the tensile strength of his cures* (R., p. 678). Petitioner is welcome to whatever tribute there is to the Kratz paper in Whitby's testimony.

Shepard of Firestone is mentioned as commending the Kratz paper and Daniels, one of respondents' witnesses is stated to have referred to it as "interesting", and as conveying definite information. Shepard testified that Firestone had never yet begun the commercial use of DPG and that the Kratz lecture had not stimulated his interest in DPG to anything beyond what it had been before—which apparently was very slight. As to Daniel's commendation, a paper is not an anticipation because it is interesting and informative. The question is *what* information it conveys. The Court will look in vain for any statement from Daniels that the Kratz paper contained information as to the practical utility of DPG.

The report on this meeting *made at the time* by the witness, Williams, (R., p. 776) demonstrates clearly that Kratz's casual mention of DPG made no impression on that witness. This exhibit was not a part of the evidence in the *National Aniline* case.

The fact is that there is not an iota of testimony from any of the chemists who testified to the effect that the paper disclosed the substance of the Weiss patent. Williams of the Roessler & Hasslacher Company, testified that the information disclosed in the paper was insufficient to enable him to repeat even the experiments performed by Kratz and obtain the same results. (The reason for this is explained below in subdivision (c) of this section of the brief).

It is quite true that on the application for the patent, the examiner thought the Kratz paper an anticipation of the patent in suit; but this does not conclude the matter. The examiner was clearly wrong. There was concurrence in the expert testimony of both litigants that the Kratz paper contained no disclosure of anything of practical importance and this testimony was corroborated by the behavior of those who heard the paper; for, of all the rubber chemists who heard the paper only Daniels is shown to have displayed in his subsequent behavior any interest in DPG. Moreover, it should be noted that his interest was *exclusively* in

DPG and not in MPG although according to Kratz the two substances were equal in accelerative activity. The conclusion is inescapable that Daniels had prior information as to the practical utility of DPG and Daniels testified that this prior information came from Weiss.

The respondent submits to this Court that the Circuit Court of Appeals was right in its judgment that in this state of the record it was unnecessary to discuss the technical contents of the Kratz paper. Since the petitioner, however, seeks to create the impression that the result would have been very different had the Court below considered the technical contents of the Kratz paper, it is necessary to go into that and that will be done in what follows.

(c) A CONSIDERATION OF THE TECHNICAL CONTENTS OF THE KRATZ PAPER SHOWS THAT IT CONTAINS NO SUCH DISCLOSURES AS CAN INVALIDATE THE PATENT IN SUIT.

[*Note: To a proper understanding of what follows, prior perusal of pp. 1-9 of this brief is essential.*]

The portion of the Kratz paper dealing with DPG purports to be based on the alleged Falls experiment of 1918 (R., pp. 374, 375) which, it will be recalled, the respondent has already discussed *supra* at pages 66, *et seq.* These Falls experiments, it will be recalled, were made with a standard formula containing only raw rubber, sulphur and accelerator, to check up on the results of the Norwalk experiments performed with the same series of accelerators but with a formula containing, besides the accelerator, sulphur and raw rubber, a considerable quantity of zinc oxide.

In both series of experiments the aim was to determine the comparative activity, as accelerators, of the substances tested. The Kratz paper says (R., p. 838):

> "The activities of the various substances were compared in the mixture previously mentioned—92.5 parts

of rubber and 7.5 parts of sulfur—taking as a standard the effect obtained with one part of aniline, vulcanized for 90 min. at 148° C."

In the footnote on the same page of the paper it is stated:

"The comparisons were made at what was adjudged to be in each case the correct cure, as measured by the physical properties of the various mixtures only. Owing to this fact, the values assigned in Tables I and II were not found to be in strict agreement with their respective sulfur coefficients as determined in the subsequent experiments. Such comparisons, based on physical properties alone, are apt to be misleading due to the toughening action imparted to the rubber when certain accelerators are employed; this effect is very noticeable in the case of *p*-phenylenediamine."

In other words the results in Tables I and II were announced in the paper itself as "apt to be misleading." Just what was the inaccuracy the possibility of which was thus admitted. He says, "* * * the value assigned in Tables I and II were not found to be in strict agreement with their respective sulfur coefficients * * *" By "sulfur coefficient," Kratz meant a measure of the amount of sulphur found in the product chemically united with the rubber and therefore a measure—other factors, including time, being kept constant—of the degree to which the "accelerator" used has speeded up this union (R., pp. 403-404, 658-659). This was what Kratz was interested in in the paper, the subject matter of which he states as follows (R., p. 826):

"The present paper records a portion of the results procured in an attempt to obtain further information in regard to the action of certain organic substances *in accelerating the vulcanization reaction* * * * The activities of the substances from a practical standpoint were considered of secondary importance." (Italics ours.)

It is as a measure solely of the extent to which the union of sulphur and rubber is promoted by the substance tested that

Kratz admits that his values in Tables I and II are "apt to be misleading."

The values were likely to be inaccurate and misleading because of "the toughening action imparted to the rubber when certain accelerators are used"—that is, certain "accelerators" have the capacity to improve the product over and above the improvement resulting from the mere speeding up of the chemical union between the sulphur and rubber. This is to say, as respondent has set forth at pages 1-9 of this brief, that the physical properties of the product—and therefore the utility of the "accelerator"—are not necessarily related to this capacity of "accelerators" to promote this union (R., pp. 658-659). Kratz insisted on this toughening effect over and over again, especially on cross-examination, apparently unconscious of its importance to the respondent's case (R., pp. 398, 403, 414).

Beyond the statement in the footnote already quoted in reference to the toughening action of *p*-phenylenediamine and the results of the later experiments in the determination of the sulphur coefficients, there is, in the paper no clue as to which of the thirteen substances in Tables I and II have this "toughening" effect on the rubber. (Table II has nothing to do with DPG). If Kratz determined the sulphur coefficient of DPG, it does not appear in the paper. *There is, then, absolutely nothing in this paper that discloses, either directly or inferentially, that DPG is one of the substances that have this toughening effect on the rubber;* but at page 413 of the record will be found Kratz's testimony at the trial of the present case to the effect that DPG does have this capacity to improve the rubber product over and above the improvement resulting from the mere speeding up of the union between the sulphur and rubber. See also R., pp. 398-399, 403-404, and 414. In this statement Kratz was corroborated by Whitby (R., pp. 37-41) and Williams (R., 659).

The value given for DPG in Table I of the paper was, then, clearly inaccurate and misleading as a measure of the degree,

to which DPG speeds up the chemical reaction between the sulphur and rubber. Was it an accurate and practical measure of what Kratz called "the activities of the substances from a practical standpoint"? It was *not,* as respondent will now show.

Table I is reproduced below:

"Table I—Relative Activities—Thiourea Series.

Parts Required to Equal One Part Aniline

Aniline	1.000
Urea	0.250
Thiourea	0.300
Monophenylthiourea	0.450
Diphenylthiourea	0.850
Monophenylguanidine (a)	0.075
Diphenylguanidine (Sym)	0.075
Triphenylguanidine	0.500"

The table looks very accurate and scientific with its values carried out to three decimal places, but its author himself shows that this seeming accuracy is delusive. Just how delusive it is he divulged at the trial of the present case.

If the court will turn to page 374 of the Record it will find the following testimony by Kratz:

> "Q. State what work you did in testing these accelerators covered by Tables I and II, without zinc oxide and when and where you did it? A. This work here without zinc oxide as represented by the Tables shown in Exhibit "E" were practically all done at the Falls Rubber Company and covered a considerable period of time. You will note that *there are no physical tests under these experiments* and that *the results were all carried on,* as I previously outlined, *by vulcanizing slabs and using the thumb and tooth test,* simply to check up that there were no unusual discrepancies between the use of zinc in the formula and without zinc in the formula." (Italics ours.)

And if Table I be regarded, contrary to Kratz's testimony, as based on the Norwalk rather than the Falls experiments,

its status is not improved; for Kratz in his answer to XQ301 at page 404 of the record stated that in his Norwalk tests the same crude "thumb-and-tooth" method of determining the cures was used.

It is obvious that the accuracy of Kratz's table of values depends directly upon the accuracy with which the sameness of the degree of vulcanization effected is determined. That was his standard of comparison (R., p. 838). It is elementary science and ordinary common sense that the sameness of the degree of vulcanization effected with the various accelerators could not be accurately determined by Dr. Kratz by merely biting and pulling and pinching the cured slabs of rubber. Moreover, Kratz stated in the paper (R., p. 830) that the conditions of his experiment did not permit of a differentiation between MPG and DPG. Just why, he does not explain but his testimony at pages 407 and 408 of the Record indicates that perhaps the answer is that he was uncertain which substance he was dealing with. If this is true, it reflects still further upon the value given to DPG in Table I. But, however that may be, it is plain that this very accurate and learned-looking table of Dr. Kratz's is so infected with error and inaccuracy as to be utterly worthless as science and utterly misleading for practical purposes.

This is, of course, the reason why Williams of Roessler and Hasslacher, though he tried three times to duplicate the Kratz work, was unable to obtain anything like the same set of values (R., pp. 654, 655).

Defendant's counsel did not cross examine on this destructive testimony.

Williams made a comparative table (Plaintiff's Exhibit 20) which demonstrated how unworkable in practice, the Kratz table really was (R., p. 779). Weiss' patent, it will be recalled, suggests as an illustrative compound 50 parts rubber, 45.5 zinc oxide, 3.5 sulphur, 1 DPG. This is 2% on the rubber, in the language of the practical rubber man. Now it takes thirteen times as much aniline as DPG to do the same work, ac-

cording to Kratz. Therefore, as shown in the third column of Plaintiff's Exhibit 20, it would take 26% aniline on the rubber to cure the compound illustrated in the patent. This would result in a compound "which of course every rubber compounder knows is impossible. You cannot add it. The stock would run all over the floor. It is very soft. It also shows (Exh. 20) that you would have to use 22.1 parts of thiocarbanilid, 11.95 anhydroformaldehydeaniline. These quantities of course we know are absurd for use as accelerators in vulcanization. * * * You couldn't get a cured stock containing 26 parts of aniline. If you would vulcanize that I don't think you could get it out of the mold; it would be in a flowing condition" (R., p. 672).

No testimony of this character attacking the Kratz paper on its merits was submitted in the National Aniline case. Nothing was introduced in the case at bar to refute this testimony.

There is no evidence in the *record* that the formula specified by Kratz in Table I would *or could* produce a single commercial article. There is not a single iota of testimony to the effect that any practical rubber work ever was based on the Kratz table of values except Kratz's highly improbable story of the manufacture of the three hundred inner tubes at Falls. As respondent has already shown, this story of Kratz' is not only improbable, but completely uncorroborated.

On the other hand, the practical utility of the formula given in the patent in suit was fully demonstrated. Williams testified (R., p. 670) that the formula specified in the patent would *produce a very good quality of tennis balls, toys, rubber gloves, rubber heels, tennis soles, soft gaskets, white aprons, tire rubber stocks, etc., and this testimony was not refuted or challenged.*

Thus far we have considered only the possibility that the Kratz paper might be an anticipation of Weiss' disclosure that DPG shortens the time required for curing rubber prod-

acts. It only remains to show how absurd it would be to hold it an anticipation of Weiss' disclosure in his patent as to the capacity of DPG to improve the rubber product. Aside from its presence in Table I, the only reference to DPG contained in the Kratz paper is, a short comment of a sentence or two (R., p. 830) upon the fact that MPG and DPG were found to be more active than TPG. This fact shows how little the paper was concerned with DPG and how slight was Kratz's interest in it.

In the paper there was not one word as to how good or how bad the DPG rubber product was. The sum of the Kratz disclosure as to DPG was that a certain proportion of that substance, used in a rubber formula, would produce a cured slab *which, when pinched and pulled and bitten, felt the same to him as slabs cured under similar conditions with different proportions of other accelerators.*

This should be contrasted with Weiss' disclosure in the patent in suit as to the qualities of the DPG rubber product (R., pp. 718-718a):

> "I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but *results in a final product much superior in texture, durability and aging qualities* over that when the triphenylguanidine is used. *A greatly improved product* also *results* when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards *elasticity, aging qualities* and *freedom from 'bloom'.*"

And again:

> "It will therefore be appreciated that when using the *accelerator according to my invention the vulcanization is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound.* Furthermore,

by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness *without danger of over-curing the softer or more elastic parts."* (Italicization added.)

The matter needs no comment. It is manifest that the *Kratz paper contained no disclosure comparable to* the foregoing.

The petitioner contends that whatever work of value with DPG was *done by* Weiss was *done subsequent* to the Kratz lecture and inspired by it. If this is so the X-book records would show a marked difference between Weiss' method of working previous to the lecture and his method thereafter. Let us see what is the fact.

Daniels came back to Youngstown with his copy of Table No. I September 7, 1919. Weiss had three dated and one undated DPG tests in the X-book prior to the lecture and eight afterwards. The tables below show the percentage of DPG on the rubber in each dated test. Kratz' percentage on the rubber works out to .08% from the figures given in the paper—that is, .075 parts of DPG on 92.5 parts of rubber.

EXPERIMENTS OF WEISS.

Pre-Katz	% on the Rubber	Post-Kratz	% on the Rubber	Ratio of Weiss' % on the Rubber to That of Kratz
/10/19 (2034E)	2.0	9/29/19 (2010H)	1.7	20 to 1
'21/19 (2006H)	6.3	10/ 3/19 (2064D)	2.0	25 to 1
/ 4/19 (2042A)	3.7	10/12/19 (2059D)	2.0	25 to 1
		10/12/19 (2059E)	2.0	25 to 1
		11/ 9/19 (2059F)	2.0	25 to 1
		11/ 9/19 (2059G)	2.0	25 to 1
		12/19/19 (2065C)	0.3	4 to 1
		12/19/19 (2065D)	1.1	14 to 1

If Weiss had been guided by the Kratz results rather than by his own tests, he would have reduced the amount of DPG to some figure near the .08% shown in the Kratz table. But not only did he never come near the .08% of Kratz, but his closest figure to it, .3%, *four times as great*, was not tried until December 19, more than three months after he had the Kratz figures. And in the ilustration in the patent, his percentage is 2, in line, not with the .08 of Kratz, but with his own experiments—pre-Kratz and post-Kratz. His percentage of 2 in the patent is 25 times that of the Kratz table.

It is no wonder Kratz failed to discover in his Norwalk experiments and those alleged to have taken place at the Falls Company that DPG had such great capacity to improve the rubber product. He did not use it in sufficient quantity.

The lecture showed Weiss that Kratz was working on DPG as a possible accelerator and that he knew something about its speed, but not much.

Whitby's testimony on cross examination showed that he did not learn of the advantages of DPG over other accelerators until 1923, after the issuance of the patent in suit. The Kratz paper was familiar to him, as his testimony on pages 67 and 68 shows, but he learned nothing of the advantages of DPG over other accelerators from that (Rec., p. 69).

Authorities need scarcely be cited to show that work such as Kratz's was no anticipation of the patent in suit. If Weiss had done nothing at all up to the Kratz lecture, he would still be entitled to his patent, for he would be well within the language of this Court in *Whitely* v. *Swayne*, 7 Wall. 685, 687:

> "Clearly if any other person had chosen to take up the subject of the improvements, where it was left off by Steadman, he had a right to enter upon it, and if successful, would be entitled to the merit of them as the original inventor, for *he is the first inventor, and entitled to the patent, who being an original discoverer, has first perfected and adapted the invention to actual use.*" (Italics ours.)

In *Coffin* v. *Ogden*, 18 Wall. 120, 124, this Court said:

> "If the thing were embryonic or inchoate; if it rested in speculation or experiment; if the process pursued for its development had failed to reach the point of consummation, it cannot avail to defeat a patent founded upon a discovery or invention which was completed, while in the other case there was only progress, however near that progress may have approximated to the end in view."

It is submitted that Kratz's attempts were not even near to the acomplishment of Weiss.

The petitioner affects to contend that Weiss, himself, has admitted that Kratz was the true inventor of DPG rubber and the process for producing it. He points to the application for employment made by Weiss subsequent to his departure from Republic. Weiss mentioned his discovery of the process for the cheap manufacture of DPG and referred to the Kratz paper in corroboration of the importance of his accomplishment. The attempt is to construe this into an admission that Kratz was the true inventor of the patent in suit. In considering this contention the court should bear in mind that early in 1920 when these applications for em-

ployment were made by Weiss, he was under the impression that a patent could not be obtained for DPG rubber and the process for making it. In other words, he had been led to believe that his important accomplishment was the perfection of the method of the cheap manufacture of DPG. It was only natural that he should refer to a paper read before the American Chemical Society as substantiating, however vaguely, his representation that he had made a discovery of real value. The respondent invites the court to consider these events carefully, for such consideration will show that they cannot possibly be construed as admissions of the import contended for by petitioner.

Petitioner also relies on the fact that when, upon Weiss' application for the patent in suit, the Patent Examiner referred to the Kratz paper as an anticipation, Weiss availed himself of his privileges under Rule 75 of the Patent Office, permitting an applicant to establish by affidavit a date for his invention earlier than that of a cited anticipation. The contention is that this was an admission that the Kratz paper constituted an anticipation.

The court should not overlook that the Patent Office practically invited Weiss to take advantage of Rule 75 rather than contest the finding of anticipation. (R., p. 895.) In view of this method of proceeding in the Patent Office, how can it possibly be contended that Weiss admitted that the Examiner was right in his finding that the Kratz paper constituted an anticipation of his patent? Weiss simply availed himself of one of two alternative modes of proceeding.

At the time this application was pending, Weiss and his assignee, the respondent here, were encountering competition from large and powerful chemical companies. (R., pp. 1011 and 1018.) It was therefore necessary to have the patent issued as quickly as possible to protect the business then being threatened. Had Weiss elected to contest the sufficiency of the Kratz paper, a prolonged controversy with the Patent Office might have developed with destructive consequences to

the then infant business. In view of his invention prior to the lecture as established by the evidence in the present record, he was clearly within his rights, and he clearly acted honorably as well, in acting on the invitation of the Patent Examiner to establish the fact of his prior invention by means of affidavits in accordance with Rule 75 of the Patent Office.

The respondent is wholly at a loss to understand how Weiss availing himself of the privileges that the law accorded to him can possibly be held against him. He took the shortest way to the patent that the law provided. That is all. The practice under Rule 75 is well established in the Patent Office and has received the sanction of the courts. *Thacher* v. *Mayor*, 219 Fed. 909, 910; *Deering* v. *Winona Harvester Works*, 155 U. S. 286, 298.

These cases not only approve the practice under Rule 75 but hold that in a subsequent suit on a patent issued pursuant to an affidavit presented under the rule, the party attacking the patent must disprove the truth of the facts shown by the affidavit. Not an iota of proof of this character has been tendered in this case.

This fact is a sufficient comment on the contention of the petitioner that the patent was obtained by a misrepresentation of the facts. The effort is to make the present appear to be an unusual case. It must be clear to the court that this is not so.

Summing up, then, the consideration of the Kratz paper, it is shown not only by the expert testimony in the case and not only by an analysis of the actual technical contents of the paper, but also by the implications of the behavior of the parties involved that that paper neither was, nor was understood to be, an anticipation of the patent in suit.

POINT IV.

The Weiss patent disclosed patentable invention.

[Note: To a proper understanding of what follows, prior perusal of pages 1-9 of this brief is essential.]

The defendant contends that the disclosure of the patent does not show invention. The trial court did not pass upon this question; but the Circuit Court of Appeals held expressly that the patent disclosed invention, approving Judge Manton's judgment of the same tenor in the *National Aniline* case. The Circuit Court of Appeals in the latter case assumed patentable invention and, of course the Patent Office thought there was invention disclosed or it would never have issued the patent in suit.

The claims of the patent herein chiefly relied upon are Nos. 5, 8, 9 and 12. Nos. 5 and 8 claim the process of treating rubber or similar materials by combining with the rubber a vulcanizing agent and, in No. 5, a di-substituted guanidine; and, in No. 8, diphenylguanidine. Nos. 9 and 12 cover a vulcanized compound consisting of rubber or similar material combined with a vulcanizing agent, and, in No. 9, a di-substituted guanidine; and, in No. 12, diphenylguanidine. Claims 5 and 9 are therefore somewhat broader than claims 8 and 12, in that the latter refers specifically to DPG, which, however, is a di-substituted guanidine.

(a) THE BROAD CLAIMS.

In his brief (pp. 108 to 113) petitioner contends that there are special considerations which apply to the broad claims of the Weiss patent. While these contentions of the petitioner are not all strictly pertinent to the question of invention, it seems best to dispose of them at this point.

The petitioner's argument is that the Weiss claims to di-substituted guanidines as accelerators were anticipated by a reference by a French writer, Du Bosc, to "diaminoguani-

dine" as one of "other interesting guanidine derivatives which are capable of acting as vulcanizers (accelerators". (R., pp. 934 to 939.)

Now, this substance is so unstable that it cannot exist as such. It is one of those unstable organic bases that, in theory, ought to exist because salts of it exist, but which always slips through the chemist's fingers, when he tries to isolate it, changing into something else. Petitioner's own expert admitted that diaminoguanidine could not exist alone so that a cure of rubber could be made with it (R., pp. 510 to 511) as indeed petitioner does also at page 109 of his brief.

But the petitioner goes on:

> "When dealing with such substances, chemists know perfectly well what to do. They mix them with something else which does not affect their serviceability but does maintain them stable. In the case of an unstable amino-guanidine, they mix with it the necessary ingredients *to form the bicarbonate of salt of the aminoguanidine.*" (Italics ours).

A high school boy knows that the salt of a substance is a substance different from the substance itself. Diaminoguanidine bicarbonate is no more diaminoguanidine than calcium carbonate (lime or marble) is calcium (which is a metal); nor than sodium bicarbonate (baking soda) is sodium (which is another metal). Respondent is at a loss to account for this section of petitioner's brief. It seems incredible that petitioner is ignorant of this elementary fact of chemistry.

The same is true of the alleged anticipation by Twiss. Twiss in the very section of his paper which petitioner quotes, says that it is a bicarbonate salt of which he is speaking. Twiss, moreover, spoke only of aminoguanidine which is not a di-substituted guanidine at all.

The broad claims of the Weiss patent speak of di-substituted guanidines and not of the salts thereof.

Further contentions are made that the broad claims are broader than Weiss' invention and that there are some di-substituted guanidines that are not accelerators. Weiss' work,

by petitioner's own admission, extends to ditolylguanidine and there can be no doubt that Weiss as the pioneer worker in the rubber art with the di-substituted guanidines, diphenylguanidine and ditolylguanidine, not to speak of the other di-substituted guanidines with which he has worked, is entitled to a wide range of equivalents. Many of these di-substituted guanidines are chemically so similar to DPG and the other di-substituted guanidines with which Weiss had worked when he made disclosure in the patent of his discovery that "the di-substituted guanidines, particularly diphenylguanidine, are particularly effective as accelerators", that unless the Weiss claims were construed to include them, those claims would be commercially worthless. The broad claims are at least thus broad.

But the short answer to this whole section of petitioner's brief is that the limits of the broad claims are not an issue in this suit. The only issue here involved as to these broad claims is whether they are *broad enough* to cover DPG. That they are is obvious since it is not disputed that DPG is a di-substituted guanidine. The attempt of the petitioner to induce this court to pre-judge possible future cases should, then, clearly fail. The claim of infringement should be sustained under the broad claims as well as under those that refer to DPG specifically.

(b) THE SPECIFIC DPG CLAIMS.

The Petitioner's Argument.

The petitioner's general contention of want of invention is based on the proposition that the guanidine family, so-called, was known before Weiss to have accelerative qualities and that TPG especially was known as a vulcanization accelerator. Upon the assertion that DPG is a near relative of TPG in the guanidine family, it is argued that the conception of the efficacy of DPG as a practical vulcanization accelerator did not involve that "leap of the imagination" which is said

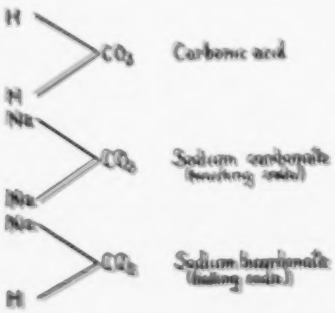
to characterize invention. The petitioner points to the fact that a reference to DPG appeared on the same page in Richter's Chemistry as did a reference to TPG, and likens the inspiration that led to the experiments with DPG to the selection by a plumber from his bag of a tool slightly different from that which he has been in the habit of using.

The Petitioner's Fundamental Error.

It is submitted that whatever plausibility the petitioner's contention may seem to possess rests on the similarity of the names, "diphenylguanidine" and "triphenylguanidine." They *seem* so much alike to ear and eye. But similarity of the chemical names of substances, as any chemist knows, connotes no similarity between the substances denoted beyond similarity in molecular structure.

If the Court will at this point turn back to pages 8 and 9 of this brief where the structure of guanidine and its phenylated derivatives, DPG and TPG, are diagrammed, it will see what the molecular relationship is between these substances.

Just as DPG and TPG are built up from the guanidine molecule by the substitution of phenyl for hydrogen in that molecule, so washing soda (sodium carbonate) and baking soda (sodium bicarbonate) are built up from the carbonic acid molecule by the substitution of sodium for hydrogen therein, thus:



The parallel is obvious, yet any housewife knows that the uses of washing soda and baking soda are totally different. If told they were chemically almost identical she would think it a strange identity indeed.

Just how little chemical similarity, or even identity means in terms of practical utility is further apparent when it is remembered that coal, graphite, and diamond are, to the chemist, all carbon. If it be thought that in some abstruse way the usefulness of a substance can necessarily be predicted from a knowledge of its molecular structure, there is the expert testimony to the contrary (R., pp. 674 to 675, 781). The testimony of the behavior of the experts is even more eloquent. Though the superiority of DPG as a commercially useful accelerator is now conceded and though it is conceded that the utility of TPG was old before Weiss, Weiss is the only man who made any real effort to find out the utility of DPG or to make it commercially available.

The presumption of validity arising from the issue of a patent is unusually strong in the present case.

It is well settled that the issue of a patent raises a sufficient presumption of invention to sustain it if none of the recognized rules of exclusion, to be hereinafter discussed, defeat invention. It should be noted that this presumption in the present case should be unusually strong; for in his application for the patent in suit Weiss frankly stated that TPG had been known and used before his work on DPG and the di-substituted guanidines. Yet the Patent Office issued the patent without a doubt as to the existence of patentable invention in the Weiss disclosure.

The force to be given this presumption of validity has been well expressed by Judge Witmer of the Middle District of Pennsylvania in *Ward Baking Company* v. *Hazleton Baking Company*, 292 Fed. 202, 204:

> "The grant of the patents carries with them the presumption of their validity. The prima facies of validity

is so strong that the burden of proof upon a defendant to establish defenses that attack the validity of a patent is the same as that upon the prosecution in a criminal case. Courts are not permitted, therefore, to constitute themselves into a board of reviewing examiners and on nicely balanced consideration find that the patent office examiners were in error. The grant of the patent carries with it the respect due a contract made on behalf of the government by those expert and authorized to act for it in honesty and good faith, and unless proof is forthcoming carrying conviction beyond reasonable doubt to the contrary, its validity will not be impeached."

If either element of the Weiss disclosure shows patentable invention, the patent in suit must be sustained.

The patent in suit disclosed two discoveries, first, the ability of DPG to speed up the vulcanization process and, second, the ability of DPG to improve the resulting product. There is not one of the alleged anticipations in the present case that discloses anything as to the second of Weiss' discoveries, as the analysis in the foregoing sections of this brief demonstrates. What little was known about DPG before Weiss related to its mere speed as an accelerator. That little—work of Kratz—was, as has been shown, vague and inaccurate. The Court will look in vain through the work of Kratz or any of the other alleged anticipations for any disclosure as to the capacity of DPG to improve the rubber compounds made with it. Weiss was the first and only person to discover this ability of DPG to improve the product. Therefore, even if the prior state of the art were conceded *arguendo* to be such as to preclude invention in the discovery of the mere speed of DPG, the second discovery would still be enough to sustain the patent.

The Weiss invention required more than mere "mechanical" skill and was more than a substitution of materials.

Patentability under our statutes involves three requisites: novelty, utility, and invention. *Novelty* must be conceded in

this case. Neither DPG nor any other di-substituted guanidine accelerator was ever used prior to the events in this record. *Utility* has been amply demonstrated. *Invention* is a question of fact, in resolving which there are no positive legal rules. As stated by Mr. Justice Brown in *McClain* v. *Ortmayer*, 141 U. S. 419, 427:

> "The truth is the word (invention) cannot be defined in such manner as to afford any substantial aid in determining whether a particular device involves an exercise of the inventive faculty or not."

As a result, certain negative rules of exclusion have grown up. Without endeavoring to enumerate all of them it has been said that mere mechanical skill is not invention, mere workmanship is not, mere omission of parts is not, mere substitution of materials is not, mere change of form, proportion, or degree not, mere substitution of equivalents is not, nor is mere rearrangement. These are the only exclusions having any possible bearing on the present case. Invention cannot be denied to the patent in suit under any of them.

Presumably the defendant relies especially upon the rules relating to mechanical skill, and substitution. It would not be helpful to endeavor by citation of authority to show that the discovery of DPG was more than an exercise of mechanical skill. Each discovery of this character rests on its own peculiar facts. Judicial decisions in other cases are not of assistance. But it is palpably absurd to argue that the long series of experiments recorded by each alleged inventor in this case with a material that had to be extracted by an unfamiliar laboratory process was nothing more than the mere selection by a plumber from well-known tools in his bag.

The mechanical-skill rule of exclusion is most frequently applied to deny invention to a discovery of which it can be said that any skilled artisan would have constructed it if he had been faced with a real need for the article. In the present case it is sufficient answer to any argument based on the

rule thus explained to point to the fact that rubber chemists the country over were engaged in a bitter competition to discover exactly the thing disclosed in this patent. Obviously, the work of Weiss was not work which any skilled artisan could have been expected to have done in case of need, for the need was general and all the artisans were at work. The fact that others were seeking the subject-matter of the patent without finding it is strong evidence of invention. *Carnegie Steel Co.* v. *Cambria Iron Co.*, 185 U. S. 403, 446; *Brill* v. *North Jersey Street Railway*, 124 Fed. 778, 779; Walker on Patents, 5th Ed. 726. The witness Brill, for the petitioner, testified that he went through Richter many times and that the book was a much used text in the Republic laboratory. But it never occurred to him to use DPG, although he was searching for accelerators (R., p. 304).

Nor can invention be denied under the rule of exclusion relating to substitution of materials. For it is well settled that wherever substitution of materials results in an *improved* machine or product or in a *great commercial economy*, the substitution does involve invention. *Hicks* v. *Kelsey*, 18 Wallace 670; *George Frost Co.* v. *Samstag*, 180 Fed. 739.

The demonstrated utility of the Weiss patent, which the petitioner is estopped to deny, requires that any doubt on question of invention be resolved in favor of the patentee.

It is obvious that the petitioner's whole argument fails to take any account of the essential quality in any discovery which the patent law strives to protect, to-wit, the utility thereof to the public. No matter how simple the discovery may seem to be, if something new and of value has been given to the world, the structure will be held to involve invention. The proposition is well stated by Judge Manton in his opinion in the *National Aniline* case:

> "I am satisfied that the use of diphenylguanidine as in the plaintiff's process, involved invention. Using it advanced the art of rubber making. Its utility and the

consequences which followed, fully support the real practical test of the sufficiency of an invention. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed. (*Smith* vs. *Goodyear*, 93 U. S. 486). This substitution involved a new process of manufacture to develop a new use of the properties of diphenylguanidine and there was a new and useful result obtained. (See *Smith* vs. *Goodyear*, supra; *Rumford Chemical Works* vs. *N. Y. Baking Powder Co.*, 134 Fed. 385; *Genl. El. Co.* vs. *Hoskins Mfg. Co.*, 224 Fed. 464.)"

Nor is it open to this defendant to dispute the existence of patentable utility in the Weiss patent. It is well settled that where a defendant has adopted the advantages of the patent in place of what it had formerly used under the prior art, that defendant cannot dispute the patentable utility of that which its use admits involves patentable utiliy.

"Whether it (advantageous result of improvements) exists in sufficient degree to be of great practical utility is in dispute, but the defendants have adopted this construction and obtained whatever advantage in it there may be, and they cannot dispute its patentable utility."

Cummer & Son v. *Atlas Dryer Co.*, 193 Fed. 993, 997 (6th C. C. A.).

To the same effect is *Brammer* v. *Schroeder*, 106 Fed. 918, 926 (8th C. C. A.).

The figures as to the commercial use of DPG are conclusive as to the utility of the invention. In 1924, according to the United States census figures put in evidence, 1,018,609 pounds of DPG were sold as against 340,829 pounds of TPG. (R., p. 643.) When it is recalled that one part of DPG is equal to eight parts of TPG, and that there is little difference in cost between one part of each, the tremendous saving to the rubber industry effected by Weiss' discovery can be appreciated. Add to this DPG's effect in improving the quality of the product and the importance of Weiss' contribution to the art is seen.

The following excerpts from a letter, written by the witness, Williams, of the Roessler & Hasslacher Company, to Mr. Colby Dill of the same company before the present litigation commenced but after the respondent had put DPG on the market, shows the opinion of a then competitor as to the utility and efficacy of DPG.

> "We are attaching complete reports on tests made recently on various accelerators. I wish to draw particular attention to the results shown for diphenylguanidine * * *
>
> "When operating at 307 degrees F., corresponding to a pressure of 60 lbs., we find that we are able to produce a tensile strength of 3446 lbs. in 5 minutes, whereas the maximum under the same condition for Hexa is only 2687 lbs. which is produced in 30 minutes. Also for these two stocks we find that the elongation for diphenylguanidine is 730 as against 520 for hexa, which shows that the diphenylguanidine has produced a better stock physically than the Hexa produced. At 50 lbs. and 40 lbs. the length of time necessary for maximum cures when using diphenylguanidines are about ¼ as long as it is necessary to cure to the maximum when using Hexa. At the same time the diphenylguanidine stocks in every case show a very much superior maximum tensile strength.
>
> "These results would show that if a tire manufacturer used diphenylguanidine as his accelerator, he would be able to produce a very superior article by using a low per cent. of diphenylguanidine and curing for a fairly long period at a low temperature. In this manner he would be able to thoroughly heat his tire thru, which would facilitate the proper vulcanization of the underlayers, that is, skim coat, friction and breaker. The formulas for the underlying stocks could readily be adjusted by putting a slightly larger quantity of diphenylguanidine in them so that they would reach their optimum cure at the same time that the outer coat or tread reached its optimum cure. *We cannot help but consider that this accelerator is the best accelerator for tire stocks that we have yet come across.*" (R., pp. 664-666.) (Italics ours.)

Nor does the fact that DPG was a substance known to chemists long before the work of Weiss militate against the patentability of his discoveries. Improvement of the character above noted has always been regarded as invention, as the following language from *Loom Co.* v. *Higgins*, 105 U. S. 580, 591 makes clear:

> "It may be laid down as a general rule, though perhaps not an invariable one, that if a new combination and arrangement of known elements produce a new and beneficial result, never attained before, it is evidence of invention."

In *Westmoreland Specialty Co.* v. *Hogan*, 167 Fed. 327, it was held that the discovery of a new quality or use in a familiar device constitutes invention. In that case a celluloid dredge for the top of saltcellars was held to constitute patentable invention, although a like dredge had been used on the top of talcum powder cans. The patent was sustained because when used on saltcellars the celluloid dredge prevented the absorption of moisture by the salt, a desirable result. Talcum powder does not cake or become damp and consequently the problem of preventing the absorption of moisture was not present when talcum powder was involved. The discovery of the special quality of that celluloid dredge when used on saltcellars constituted something new. So here the discovery of DPG's usefulness in speeding the process of the vulcanization of rubber and in improving the rubber product is the sort of advance in the useful arts for which patents are granted.

The rule in regard to utility is this, that if any doubt of invention exists, that doubt is to be resolved in favor of the patentee if the utility of the patent is shown. Thus, in *Smith* v. *Goodyear*, 93 U. S. 486, this Court said at page 495:

> "Webster, on the subject-matter of patents, page 30, says: 'The utility of the change, as ascertained by its consequences, is the real practical test of the sufficiency of an invention; and since the one cannot exist without the

other, the existence of the one may be presumed on proof of the existence of the other. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed.' We do not say the single fact that a device has gone into general use, and has displaced other devices which had previously been employed for analogous uses, establishes in all cases that the later device involves a patentable invention. It may, however, always be considered; and, when the other facts in the case leave the question in doubt, it is sufficient to turn the scale."

Especially applicable to the present case is the following language of the opinion at page 496:

"But where there is some such new and useful result, where a machine has acquired new functions and useful properties, it may be patentable as an invention, though the only change made in the machine has been supplanting one of its materials by another. This is true of all combinations, whether they be of materials or processes. In *Crane* v. *Price*, 1 Webst., Pat. Cas. 393, where the whole invention consisted in the substitution of anthracite for bituminous coal in combination with a hot-air blast for smelting iron ore, a patent for it was sustained. The doctrine asserted was, that if the result of the substitution was a new, a better, or a cheaper article, the introduction of the substituted material into an old process was patentable as an invention. This case has been doubted, but it has not been overruled; and the doubts have arisen from the uncertainty whether any new result was obtained by the use of anthracite."

If the substitution of anthracite for bituminous coal in a process for smelting iron ore was sustained as an invention because the introduction of the substituted material resulted in a new, better or cheaper article, clearly the introduction of DPG in lieu of other accelerators in the vulcanization process, with its resultant better rubber and cheaper process, was patentable as an invention. As Dr. Whitby, expert witness, testified, no other accelerator known at the time "ap-

proached diphenylguanidine in regard to the collection of advantages which it displayed" (R., p. 39). Petitioner admits this in his brief at page 116. See also R., pp. 662-666.

The Second Circuit Court of Appeals has stated the same proposition in the following language in *H. D. Smith & Co.* v. *Peck, etc., Co.*, 262 Fed. 415, 417:

> "Whether the structure involves invention is a question of fact, and the determining factor is not whether the achievement is difficult or easy, but whether it has, in point of fact, given the world something of real value, that it did not have—a benefit conferred upon mankind. *O'Rourke Engineering Const. Co.* v. *McMullen, et al.*, 160 Fed. 933, 88 C. C. A. 115."

See also *Individual Drinking Cup Company* v. *U. S. Drinking Cup Company*, 220 Fed. 331, 334.

There is no reason to doubt the patentability of the Weiss invention under any of the recognized criteria, but if patentable invention did stand in doubt it is clear that the demonstrated utility of the Weiss patent should determine this issue in favor of the respondent.

(c) *The finding of patentable invention by the Court below was not, as petitioner contends, the result of the court's having confused Weiss' several patents.*

Respondent has had occasion several times to refer to Weiss' separate patent covering the process for cheap commercial manufacture of DPG. The petitioner contends that the court below reached its decision only because it confused that patent with the patent in suit. In particular at page 121 of his brief he quotes as an instance of this confusion the following passage from the opinion of the Circuit Court of Appeals (R., p. 1031):

> "* * * no one prior to Weiss seems to have conceived and worked out any practical plan by which DPG's potential powers could be commercially used. The reason

> for this is plain for no one knew, or, for that matter, had tried to learn, how DPG could be produced in such quantity as to make possible its commercial use."

Many other excerpts from the opinion follow, most of which are so torn from their context as not to give a fair idea of the reasoning of the Circuit Court of Appeals. The respondent will be satisfied to have the Court read the opinion as a whole and come to its own conclusion as to whether the court below actually did confuse the two patents.

Moreover, the existence of this other patent for a process of manufacturing DPG is not irrelevant to the present case. It is very relevant. Kratz did nothing. Weiss, not by accident, but by long and persistent endeavor worked out a process for the commercial manufacture of DPG. When he came to New York in 1920 Weiss was able to convince Doty and Woodward that there would be a *commercial demand* for DPG and that it would be worth their while to back, with their time and money, his process for its cheap manufacture. It is impossible to believe that these young men would invest their money and the last eight years of their time in an enterprise for the manufacture of this substance unless they had good reason to believe that it would displace the accelerators already in use. Years before 1920 faster accelerators were known than DPG. The conclusion is therefore inescapable that Weiss disclosed to Doty and Woodward not only the speed of DPG, but also the peculiar capacity that DPG displays of improving the useful qualities of the rubber product made with it.

CONCLUSION.

The judgment of the Circuit Court of Appeals is sound and should be affirmed.

Respectfully submitted,

JOHN W. DAVIS,
JAMES J. KENNEDY,
Counsel for Respondent.

APPENDIX.

JUDGE MANTON'S OPINION.

UNITED STATES DISTRICT COURT,

FOR THE SOUTHERN DISTRICT OF NEW YORK.

DOVAN CHEMICAL COMPANY,
Plaintiff,

against

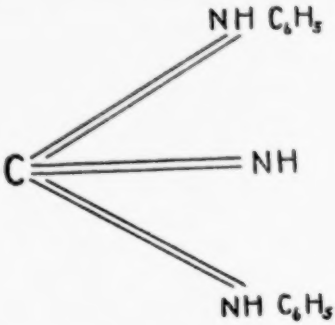
NATIONAL ANILINE & CHEMICAL CO., INC.,
Defendant.

DRURY W. COOPER, Esq.,
EDWARD W. VAILL, Esq.,
of Counsel for Plaintiff.

DEAN S. EDMONDS, Esq.,
FRANK E. BARROWS, Esq.,
Of Counsel for Defendant.

The patent in suit, No. 1,411,231, was applied for November 12, 1921, and granted March 28, 1922, and is for vulcanization accelerators. It is a process for improving rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purposes. In the art, when certain organic substances are added to rubber mix during the compounding, a catalytic or similar action is produced which causes the rubber or gum to

unite or react more rapidly or thoroughly with sulphur or other vulcanizing agents. The inventor discloses that diphenylguanidine is particularly effective for this purpose. The formula indicated is given as



Recognizing that di-substituted guanidine produced by laboratory methods had been known to chemists for years to be used in accelerators of this type, [sic] it was thought that di-substituted guanidine was not known to be efficacious or useful as accelerators in vulcanizing, nor could it be produced in sufficiently large quantities in a substantially pure form or at a sufficiently low price to be available for this purpose, and the inventor says that the use of diphenylguanidine had been unknown prior to his researches and that he found it much more powerful and effective as an accelerator in vulcanization than triphenylguanidine. The diphenylguanidine not only hastens the vulcanization but results in a final product much superior in texture, durability and aging qualities over that when triphenylguanidine is used. A greatly improved product results, particularly as regards elasticity, aging qualities and a freedom from bloom. The method of carrying out the invention is illustrated as follows: the rubber may be compounded in proportions of 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, 1 part by weight of diphenylguanidine.

They are mixed together in a suitable way, such as by milling and then vulcanized or cured in molds under heat corresponding to steam pressure of about forty pounds per square inch. This vulcanizing temperature is continued until the compound is suitably vulcanized, which requires from ten to twenty minutes, depending upon the shape and size of the article being vulcanized. This accelerator is useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as automobile tires. Indeed, this accelerator has been so successful that a large demand has been built up and a market created for it, and several of the large chemical corporations are manufacturing it. The purchasing public shows a willingness to pay for it. This is a practical illustration of its substantial value. Again, the defendant is using the process, and it too has built up a large and profitable business.

It is urged by the defendant that three others, prior to Weiss, tested diphenylguanidine as an accelerator. One George D. Kratz read a paper in September, 1919, at a meeting of the Chemical Society of Philadelphia in which diphenylguanidine was referred to as an accelerator. He, called as a witness, testified that he incorporated some twenty to thirty grams of diphenylguanidine in some tire tube stock which was sold to the Rubber City Clearing House at Akron, Ohio, in 1917. In his paper, Kratz said, speaking of his work: "We have chosen to employ only substances which have previously been cited by others and whose definite chemical composition permits comparisons with homologs or other closely related compounds." And he says that "the activities of the substances from a practical standpoint were considered of secondary importance." A mere reading of the paper before this Society is not a statutory publication under Sec. 4886 of the Revised Statutes. There was a publication in the Chemical and Metallurgical Engineering on October 1, 1919. What was printed there does not disclose the in-

vention or give it into the possession of the public fully, so that it might be practically and publicly employed. There was a complete publication by Kratz and others in the Journal of Industrial & Engineering Chemistry for April, 1920, and the application for the patent in suit was filed November 12, 1921. This publication was less than two years prior to the filing of the first Weiss application, which was on July 2, 1921. That paper refers to the diphenylguanidine as being an accelerator, but it was Weiss who was the first one to adequately test, by actual experience and to overcome the practical difficulties there were in the way of the accomplishment. Weiss was employed by the Republic Rubber Company of Youngstown, Ohio, in the Fall of 1917, and was under the supervision of the chief chemist Daniels. Up to March 8, 1918, Weiss was associated with one Carlton, who went with the Republic Company in June, 1917, about four months prior to Weiss' engagement. Carlton says that he had frequent conversations with Weiss with regard to accelerators, and that he pointed out to him many organic compounds suggesting that they be tried. It was impossible to try them except those which were easily obtainable on the market or very easily prepared, and Weiss referred him to "Richter's Organic Chemistry" and suggested after reading from that, that diphenylguanidine might be an accelerator. It was after this that Weiss went to Pittsburgh to the Carnegie Library to obtain further information on the subject of guanidines from the literature there available. He made this investigation the first week of January, 1919, under Mr. Daniels' direction. Daniels then became interested in developing diphenylguanidine as an accelerator and said that in the Fall of 1918 "I knew he had some results that looked pretty good." After returning from Pittsburg, some tests on rubber compound were made, the result of which was shown under date of February 10, 1919, and after that another test was made on the shoddy compound under date of March 21, 1919. Another test was made March 4, 1919, and still there

was another under date of September 29, 1919, and again October 12, 1919, in which diphenylguanidine prepared by the new process Mr. Weiss introduced. In the Fall of 1919, Weiss supplied Mr. Daniels with diphenylguanidine for his personal use. The X-book record of the Republic Company shows various tests made by Weiss. It demonstrates extensive work by him experimenting to ascertain the value of diphenylguanidine as an accelerator in various compounds adapted for practical use. The first test slabs were shown to Mr. Daniels at the time of Weiss' Pittsburgh visit. These slabs were made in December, 1918. The Weiss tests recorded in the Spring of 1918, were before the reading of the Kratz paper, and demonstrate that Weiss had been working on the production of diphenylguanidine in commercial quantities. He left the Republic Company on March 15, 1920. Thereafter, he visited rubber companies and at their places talked on this subject and exhibited slabs of rubber that had been cured with the use of diphenylguanidine. He then returned to New York, being unsuccessful in obtaining a position with the various rubber companies, visited the offices of the defendant and made application for employment, but did not succeed. He later visited the States Metals Company (afterwards the selling agent for the plaintiff herein) and interested officers of the plaintiff company. In May, 1920, after the organization of the plaintiff company, a plant was built in Brooklyn, New York, where diphenylguanidine was manufactured for commercial use.

The X-book referred to proved to have page 2005 torn out. This was subsequently found. This records in the first column a test of the use of diphenylguanidine and is said to have been made by Baldwin. The rest of the entries were made by Weiss. That column was under date of February 23, 1917, whereas all the other entries (none record the use of diphenylguanidine) were made in the year 1918. I am not satisfied that there was such an entry of an experiment as is indicated in column 1 at the time Weiss entered his record

regarding the use of diphenylguanidine. It is not shown where Baldwin obtained diphenylguanidine to experiment with. Baldwin's testimony as to this experiment is unsatisfactory and I decline to accept it.

Kratz is said to have disclosed his idea to others in 1916. It is said that then he experimented and reached definite conclusions as to diphenylguanidine while working for the Norwalk Rubber Company and that what he did at the Norwalk Rubber Company constituted a reduction to practice as also the occasion of making the tubes for the Falls Rubber Company in 1917. He says, speaking of his work at Norwalk under date of November 1, 1916 (report from Norwalk plant, Exhibit E), that it gives the relative accelerating values of certain substances tested. But what he did appears to have been a laboratory experiment which was abandoned because nothing further was then done until the later effort at reduction when employed by the Falls Rubber Company where the tubes were manufactured as above referred to. There thirty grams of diphenylguanidine were mixed with rubber stock made into inner tubes for automobiles and such tubes were sold as blemished rubber in Akron, Ohio. No further commercial use was made. The amount of acceleration used could have had no substantial effect in curing the rubber as compared with that used in plaintiff's process. The burden of proof is upon the defendant to establish the defense of prior public use. When the application was in the patent office, the Kratz paper was referred to, as were his experiments, and a hearing was had there. I think the issuance of the letters patent carried with it the presumption of validity and, in view of the defense offered here, should be established beyond every reasonable doubt. (Coffin vs. Ogden, 18 Wall. 120.)

> "The prophetical suggestions in English patents of what can be done, when no one has ever tested by actual and hard experience and under the stress of competition the truth of these suggestions, or the practical difficulties in the way of their accomplishment, or even whether the

suggestions are feasible, do not carry conviction of the truth of these frequent and vague statements." (Westinghouse Air-Brake Co. vs. Great Northern Ry. Co., 88 Fed. at 263.)

Mere vague and general representations will not support such a defense as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art or science to understand the nature and operation of the invention and to carry it into practical use. Whatever may be the particular circumstances in which the publication takes place his account published, to be and in effect support such defense, must be an account of a complete and operative invention capable of being put into practical operation. (Seymour vs. Osborne, 11 Wall. 516.)

I am satisfied that the use of diphenylguanidine as in the plaintiff's process, involved invention. Using it advanced the art of rubber making. Its utility and the consequences which followed, fully support the real practical test of the sufficiency of an invention. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed. (Smith vs. Goodyear, 93 U. S. 486.) This substitution involved a new process of manufacture to develop a new use of the properties of diphenylguanidine and there was a new and useful result obtained. (See Smith vs. Goodyear, *supra;* Rumford Chemical Works vs. N. Y. Baking Powder Co., 134 Fed. 385; Genl. El. Co. vs. Hoskins Mfg. Co., 224 Fed. 464.) A complete and successful invention should not be voided by proof of a number of incomplete and imperfect experiments made by others at an earlier date. Even though the experimenters may have had the idea of the invention and may have made partially successful efforts to embody it in a practical form, there is not sufficient to defeat an issued patent. This applies in cases arising under patents for chemical products. (Amer. Wood Paper Co. vs. Fibre Disintegrating Co., 23 Wall. 566.) An invention to be patentable should be com-

plete and capable of producing the result and one who has been successful in his effort should not be deprived of the consequences of that success merely because someone came near it theretofore. (Diamond Patent Co. vs. Carr Co., 217 Fed. 400.)

I think Weiss is the discoverer of the process which has borne such good results that the plaintiff as assignee should be accorded the benefits thereof.

Decree for plaintiff.

Dated: January 24, 1923.

MANTON,
United States Judge.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

DOVAN CHEMICAL COMPANY,
Plaintiff,

against

NATIONAL ANILINE & CHEMICAL CO., INC.,
Defendant.

On this application for reargument, I have examined the detailed information which has been submitted by both sides. Much of which has been argued as to the prior disclosure was before the Patent Office and there examined and held not to defeat plaintiff's claims. After carefully examining what has been submitted by learned counsel for the defendant, my views as to the facts disclosed by the evidence remain unchanged, and this requires my denying the application to set aside my former determination granting a decree for the plaintiff.

Motion denied.

Dated: February 19, 1923.

MANTON,
U. S. Circuit Judge.

CHRONOLOGY OF THE WORK OF KRATZ AND WEISS

The Center Columns Are Taken from The Chart Attached to the Petitioner's Brief.

The Matter in Red is the Comment of the Respondent.

KRATZ.		WEISS.
Graduated from Cornell University and entered employment of Diamond Rubber Company (R., pp. 337, 338), afterwards combined with Goodrich Rubber Company.	1912	
	1913	Graduated from the Free Cooper Union (R., p. 86).
Left Goodrich to enter employment of Norwalk Rubber Company (R., p. 338).	1914	
Tests were undertaken to determine the comparative amounts of various substances (of which DPG happened to be one) required to produce same cure in same time, at same temperature as arbitrary amount of sulphocarbanilide used in particular laboratory formula (R., pp. 350, 952). Sameness of cure was determined by thumb-and-tooth (R., p. 404). Kratz' superior, Russell, saw as result no reason for substituting DPG for accelerators then in use in Norwalk plant (R., p. 1023). Not proved and highly improbable.	Kratz's Norwalk Tests. About 100 tests of eight different accelerators in rubber compounds, including 9 to 12 tests with DPG, resulting in a table of relative accelerating values (Vol. II, p. 838). Kratz fully corroborated by Russell and by written records.	1916 Graduated from Polytechnic of Brooklyn (R., p. 86).
Secret and never followed up by Kratz or Falls Company (R., pp. 372, 406).	Kratz's Tubes made at Falls Co. in August and September. About 300 inner tubes made using DPG as accelerator and sold in the regular course of business.	1917 Started work on rubber with Republic Rubber Company (R., p. 91).
No evidence to prove these tests took place and results claimed indicate that they were never performed and that figures in Table I of Kratz paper came from Norwalk 1916 work. Thus, it is impossible that tests at Falls Company in 1918 should have given same results using thiocarbanilide, (diphenylthiourea or sulphocarbanilide) *without* zinc oxide as did Norwalk tests of 1916 using these substances *with* zinc oxide. Yet such are results claimed (R., pp. 374, 792).	Kratz conducted a further series of tests at the Falls Co. with the same eight accelerators previously tested at Norwalk and obtained the table of relative accelerating values which appeared later in the Kratz paper.	1918 Weiss alleged conception in February or March. No written record made. Three tests claimed to have been made by Weiss using DPG in December, all overcured. These tests were not recorded in X-book; there is no record of them, and Weiss' affidavit says the amount of DPG he succeeded in making was insufficient for a test. Corroborated by Carlton (R., p. 92). Corroborated by Halliday and Daniels (R., pp. 204, 234).
Paper contained tables as determined at Norwalk three years earlier. Paper gave no information as to superior quality of DPG rubber nor any directions as to how to produce it. Values stated in the table were inaccurate (R., pp. 654 to 656, 398 to 399, 838) by Kratz's own admission, and all practical information deliberately omitted (R., p. 409). Paper without interest to any of his hearers except Daniels. Daniels had prior knowledge from Weiss. No recommendation of DPG over other accelerators (R., p. 410).	Kratz's paper read, September 2-6. The paper was of intense interest to the assembled rubber chemists. Portions of it, including the table of relative accelerating values, were copied by many of those present. Daniels said he had never heard a paper on accelerators that was so interesting or so informative and Shepard said it enabled rubber chemists to apply the accelerators sensibly.	1919 Two or three tests using DPG made by Weiss in February and March. The date of one test has been altered in the X-book. The other two tests are on shoddy mixtures and showed no superiority of DPG over TPG. Between March 4 and September 10 no further tests using DPG were recorded in the X-book and Weiss' uncorroborated statement that some were made is inconsistent with his former testimony. Daniels, the Chief Chemist of the Republic Co. and Weiss' superior, said he was not prepared to say how good DPG was, and TPG was the accelerator being actively developed at Republic. Weiss learned of Kratz paper from Daniels. Daniels gave Weiss a copy of the table of relative activities of the Kratz paper and instructed Weiss to work with DPG. All work on TPG at Republic stopped abruptly after the Kratz paper and active work with DPG began. Numerous tests made by Weiss using DPG during October, November and December.	As result of these successful tests Weiss stopped his search for new accelerators. Tests showed *marked* superiority over all other accelerators and Weiss disclosed this knowledge to Daniels, Carlton, Seil and Greenwald (R., pp. 748, 731, 753, 613 and 904 to 905). As result of February and March tests, further tests unnecessary. Weiss worked on process of making DPG (R., p. 226). Told Nellen its value (R., p. 230). Executive officers at Republic Company not necessarily as convinced of worth of DPG at *this* time as was Weiss. Kratz's lecture convinced Daniels Weiss was right (R., p. 216). Did not stop until three months after Kratz lecture when testing of Weiss' post-Kratz and pre-Kratz work was complete and it was clear a good DPG process was at last available. In all these tests DPG was used in same proportions as in Weiss' pre-Kratz experiments. This work of Weiss' in no way followed information in Kratz paper. Weiss left Republic Company in March

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 19[illegible]

No. 102

CORONA CORD TIRE COMPANY, PETITIONER,

vs.

DOVAN CHEMICAL CORPORATION.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE NINTH CIRCUIT.

...place and results claimed indicate that they were never performed and that figures	...at the Falls Co. with the same ... celerators previously ... at Norwalk		...made by ... Carbon Co. by Harmony and Tuttle
Publication hardly noticed by rubber and chemical industries as it told nothing of commercial importance. Rubber manufacturers did not learn enough from this paper as to superiority of DPG rubber to induce them to buy DPG when DPG was offered to them at a low price. Sales of DPG in 1920—despite an aggressive sales campaign—53 pounds (R., p. 244).	Kratz's paper published, April 1st.	1920	Weiss endeavored to obtain employment by claiming he had discovered a method of making DPG and he cited the Kratz paper as showing the value of DPG as an accelerator.	Weiss left Republic Company in March and sought employment with rubber and chemical companies. Met Doty and Woodward, who tried out sample of DPG, and *immediately* accepted his proposal to organize respondent corporation for manufacture and sale of DPG. DPG offered for sale to rubber industry first in August. Total sales for 1920—53 pounds (R., pp. 244, 250 to 251).
		1921	Weiss' application filed, November 12th. 4 yrs., 2 mos. after sale of Kratz Tubes. 3 yrs., 8 mos. after Weiss alleged conception. 2 yrs., 8 mos. after Weiss alleged reduction to practice. 2 yrs., 2 mos. after Kratz's paper and after Weiss learned of Kratz's paper.	Delay immaterial so long as no statutory bar arose. Weiss during this period was busy making and selling DPG in large and ever increasing quantities, thus giving benefit of his invention to public (R., p. 246).
		1922	Weiss patent granted, March 28, 1922.	Roessler and Hasslacher paid large sum for a license under patent in suit (R., p. 260).
		1923		846,431 lbs. of DPG sold (R., p. 643).
		1924		1,018,609 lbs. of DPG sold (R., p. 643).
		1925		Approximately 2,000,000 lbs. of DPG consumed.

(32,482)

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1927

No. 182

CORONA CORD TIRE COMPANY, PETITIONER,

vs.

DOVAN CHEMICAL CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT

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RECORD.

Among the rolls, records and judicial proceedings had in the District Court of the United States for the Western District of Pennsylvania, at No. 1109 in Equity, may be found the following words and figures, to-wit:

Docket Entries.

UNITED STATES DISTRICT COURT,
WESTERN DISTRICT OF PENNSYLVANIA.

DOVAN CHEMICAL CORPORATION, Plaintiff, vs. CORONA CORD TIRE COMPANY, Defendant.	No. 1109 In Equity. On Patent No. 1,411,231 to M. L. Weiss.

June 4, 1924 Bill of Complaint filed.

June 4, 1924 Subpoena issued.

June 12, 1924 Subpoena returned served on Corona Cord Tire Co. by handing to and leaving a true and attested copy thereof with H. B. Callahan, General Manager of said Company at Butler, Pa., June 11, 1924.

June 28, 1924 *Praccipe* for appearance of Winter, Brown & Critchlow for Defendant filed.

Aug. 7, 1924 Answer filed.

Oct. 7, 1925 Hearing on Bill. Answer and Proofs.

Feb. 3, 1926 Transcript of Arguments of Counsel filed.

Feb. 3, 1926 Opinion filed and entered.

Feb. 13, 1926 Final decree entered dismissing bill of complaint with costs to defendant to be taxed.

Mar. 10, 1926 Petition of Plaintiff for appeal filed.

Mar. 10, 1926 Assignments of Error filed.

Mar. 10, 1926 Order allowing appeal filed and entered.

Mar. 10, 1926 Bond on appeal approved and filed.

Mar. 11, 1926 Citation awarded and issued.

Mar. 13, 1926 Citation returned service accepted by Winter, Brown & Critchlow, Solicitors for Defendant.

Bill of Complaint.

Filed June 4, 1924.

To the Honorable Judges of the District Court of the United States for the Western District of Pennsylvania:

The plaintiff by this, its bill of complaint, alleges as follows:

1. That the plaintiff, Dovan Chemical Corporation, above named, is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware and a citizen and resident of said State.

2. On information and belief, that the defendant, Corona Cord Tire Company, above named, is a corporation organized and existing under and by

virtue of the laws of the State of Pennsylvania, and is a resident of said State, having its principal office in East Butler, Summit Township, Butler County, Pennsylvania, in the Western District.

3. That this is a suit in equity brought under the patent laws of the United States for the infringement of the hereinafter mentioned United States Letters Patent No. 1,411,231, issued March 28, 1922.

4. On information and belief that Morris L. Weiss, on and prior to the 12th day of November, 1921, being then a citizen of the United States of America, and residing in the Borough of Brooklyn, County of Kings, State of New York, and being within the meaning of the statutes of the United States then in force the first, sole, true and original inventor of certain new and useful improvements in "Vulcanization Accelerators" and in the process of treating rubber and in the vulcanized rubber compound in which the said accelerator is used, not known or used by others in this country, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application for Letters Patent of the United States therefor, and not in public use or on sale in this country for more than two years prior to his application for Letters Patent therefor, and not having been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns for more than twelve months prior to his application for Letters Patent of the United States therefor, and no application for a patent on said improvement having been filed

by him or his representatives or assigns in any country foreign to the United States, on November 12, 1921, duly made, and on the 12th day of November, 1921, filed an application in writing with the Commissioner of Patents of the United States for Letters Patent for said invention and improvements.

5. That on March 28, 1922, all of the provisions and requirements of the statutes of the United States in such cases made and provided having been duly complied with, the said application and the said inventions and improvements or discoveries described, shown and claimed therein having been duly assigned to the plaintiff, the Dovan Chemical Corporation, a corporation of the State of Delaware, Letters Patent of the United States numbered 1,411,231 were duly issued on said application for said invention and improvements or discoveries to said Dovan Chemical Corporation, its successors or assigns, whereby there was granted to said plaintiff, its successors and assigns, for the term of seventeen years from the 28th day of March, 1922, the exclusive right to make, use and vend said inventions and improvements set forth, described and claimed therein, throughout the United States and the Territories thereof.

6. That the plaintiff asks that said Letters Patent and assignment may be deemed and taken as a part of this bill of complaint, and the plaintiff asks leave to refer to the originals or duly authenticated copies thereof, ready in court to be produced, a copy of said patent being annexed hereto.

7. That by virtue of the premises the plaintiff became and ever since the issue of said patent on the 28th day of March, 1922, has been and now

is the sole owner of the entire right, title and interest in said Letters Patent No. 1,411,231, and has been and now is entitled to sue for and collect all damages and profits for the infringement of said Letters Patent, including the infringement herein complained of.

8. That the inventions and improvements of said Letters Patent No. 1,411,231 are of great value and importance to the plaintiff; that the plaintiff and its predecessors in business have caused quantities of the vulcanization accelerator described and claimed in said patent to be manufactured and sold to the public for use in the vulcanization of rubber and rubber goods, and that the plaintiff is prepared and able to supply the demand for said invention and improvements for such purposes; that the inventions or improvements of said Letters Patent for such purposes are of great value, benefit, advantage and importance to the public, and that the public, so far as may be ascertained, since the issue of said patent, have, with one or two exceptions, generally acknowledged and acquiesced in the rights granted by said Letters Patent and the rights of the plaintiff therein and thereunder; that said Letters Patent has been specially acquiesced in by plaintiff's licensee (exclusive except as to plaintiff) which licensee well knowing the premises now acquiesces and always has acquiesced in said patent and has paid plaintiff in excess of Seventy-five Thousand Dollars ($75,000.00) as royalties thereunder; that except for the infringement herein complained of and said exceptions, the plaintiff would now be in undisputed possession, use and enjoyment of the

rights and privileges secured by said Letters Patent, and in respect of the gains and profits from the same.

9. That since the grant of said Letters Patent No. 1,411,231, containers, packages or boxes in which said vulcanization accelerator has been sold and shipped by the plaintiff and its said licensee have been marked by affixing thereon the word "Patented" together with the day and year in which said Letters Patent were granted.

10. That on information and belief, the defendant Corona Cord Tire Company, without right or license under said Letters Patent No. 1,411,231, and in violation and infringement of said Letters Patent, has, since March 28, 1922, and prior to the execution of this bill of complaint, unlawfully and wrongfully used, made, sold and offered for sale, within the United States, and is now making, selling and offering for sale within the United States, rubber and rubber products vulcanized with diphenylguanidine, employing or embodying the inventions and improvements of said Letters Patent or substantial or vital parts thereof, and thereby has infringed and contributed to the infringement by others of said Letters Patent contrary to the aforesaid rights of the plaintiff thereunder.

11. On information and belief, that the defendant herein has derived and received and will derive and receive from the infringement complained of herein, large gains, profits and advantages due to the saving in cost of manufacture of its said infringing rubber and rubber products as compared with rubber and rubber products known prior to

the invention of said Weiss as set forth and claimed in said Patent No. 1,411,231, and to the enhanced value of such rubber and rubber products to defendant and its trade by reason of the superiority thereof in material qualities required of rubber products, such as durability, tensile strength and aging, but to what amount the plaintiff is ignorant and cannot set forth; that by reason of said infringement the plaintiff has been and will be deprived and prevented from receiving, if such infringement is not forthwith restrained by this Court, all the gains and profits to which it is lawfully entitled, and which it would have derived and received and would now be deriving and receiving but for the aforesaid infringement; that by reason of the aforesaid infringement the plaintiff has been irreparably injured and has sustained damages and losses thereby; that unless said infringement by the defendant is immediately restrained by an order and writ of injunction issuing out of this Court, further and immediate irreparable injury, loss and damage will be caused to the rights of the plaintiff under said Letters Patent.

12. On information and belief, that the defendant Corona Cord Tire Company, prior to the commencement of this suit, was notified of the aforesaid rights of the plaintiff in said Letters Patent No. 1,411,231, and of the defendant's infringement and threatened infringement thereof, and warned to cease and desist from such infringement, but that the defendant failed so to do, and continues and threatens to continue said infringement of said Letters Patent.

13. On information and belief, that on or about the 1st day of April, 1920, the said inventor Morris L. Weiss called upon Messrs. Henry S. Doty and Van Lear Woodward at their office, 30 Church Street, New York City, and also disclosed said invention to them, and offered and extended to them the opportunity and option of obtaining rights under said invention of said Morris L. Weiss; that after due consideration of said offer, the same was accepted by said Henry S. Doty and Van Lear Woodward, and subsequent thereto, on or about the 3rd day of February, 1921, the plaintiff corporation was organized under the laws of the State of Delaware for the purpose of manufacturing, selling and dealing in vulcanization accelerators, to wit, diphenylguanidine manufactured in accordance with the description and claims of said Letters Patent No. 1,411,231.

14. Upon information and belief, that, pursuant to the organization of said Dovan Chemical Corporation, plaintiff herein, a factory and manufacturing plant was obtained in the borough of Brooklyn, County of Kings, State of New York, for the manufacture of said diphenylguanidine as an accelerator for use in the vulcanization of rubber; that thereafter the plaintiff, through its selling agents, first placed said vulcanization accelerator on the market, and through an active selling campaign established a large and growing demand for the same, which demand was satisfied until the destruction of its said factory by fire on or about the 8th day of September, 1921; that thereafter, with all reasonable speed and diligence, the plaintiff obtained and equipped another manufacturing plant at North Newark,

County of Essex, State of New Jersey, and upon the completion of the same, on or about the 1st day of January, 1922, immediately resumed the manufacture of said vulcanization accelerator, and together with its said licensee has since continued to manufacture and supply same for the vulcanization of rubber in large and increasing quantities.

Therefore, the plaintiff prays:

I. That a process of subpoena issued out of and under the seal of this Court requiring the said defendant to appear and make full, true, direct and perfect answer to the several matters and things set forth and charged in this bill of complaint (but not under oath, an answer under oath being expressly waived).

II. That the defendant, its associates, attorneys, officers, directors, clerks, servants, agents, workmen and employees be perpetually enjoined and restrained by the decree of this Court from directly or indirectly making or causing to be made, using or causing to be used, selling or causing to be sold, advertising or offering for sale or use, or causing to be advertised, offered for sale or use, agreeing or contracting to sell, or causing to be agreed, contracted for sale, supplying or causing to be supplied, or using or disposing of in any manner, any vulcanization accelerator or vulcanized rubber embodying or employing said inventions and improvements or discoveries of said Letters Patent No. 1,411,231, or any substantial, material or vital part or parts thereof, and from infringing upon or contributing to the infringement of said Letters Patent in any way whatsoever.

III. That a provisional or preliminary injunction or restraining order may be immediately issued

against the said defendant to the same tenor and effect as hereinbefore prayed for in respect to said perpetual injunction.

IV. That the defendant be ordered and decreed to deliver to the plaintiff any and all quantities of disubstituted guanidines and particularly diphenylguanidine, or rubber vulcanized therewith which it has in its possession or under its control, or that same may be destroyed, or that same be delivered to or be impounded by the Court for such final disposition as may seem just and proper.

V. That the defendant may be decreed to account for all such gains, profits, savings, and advantages as have accrued to or been earned or received by it, and all damages it has caused the plaintiff by reason of said infringement, and that the Court will assess the same or cause them to be assessed under its direction, and will increase the same in its discretion as provided by law.

VI. That the defendant may be decreed to pay the costs, charges and disbursements of this suit, and that the plaintiff may have such other and further relief as the circumstances and the equity of the case may require.

DOVAN CHEMICAL CORPORATION,
By H. S. DOTY,
Pres.

BAKEWELL, BYRNES & STEBBINS,
Solicitors for Plaintiff.
J. S. WOOSTER,
J. J. KENNEDY,
Of Counsel.
1717 Farmers Bank Bldg.

State of New York,
County of New York, } *ss:*

On this 29th day of May, 1924, before me came Henry S. Doty, to me personally known, who, being by me duly sworn, did depose and say that he is the President of the Dovan Chemical Corporation, the plaintiff named in the foregoing bill of complaint; that he has read said bill subscribed by him and knows the contents thereof, and that the same is true of his own knowledge, except as to matters which are therein stated to be alleged upon information and belief, and as to those matters he believes it to be true; that the reason why this verification is not made by the plaintiff personally is that said plaintiff is a corporation.

LULU C. ECKERT;
Notary Public.

[NOTARY SEAL]

Notary Public, Queens Co. No. 1584. Cert. filed in N. Y. Co. No. 621, Reg. 6121. Term expires Mar. 30, 1926.

Defendant's Answer.

(Filed Aug. 7, 1924.)

And now comes the defendant in the above entitled case and answering the Bill of Complaint herein, says:

1. Defendant does not know, has not been informed save by the Bill of Complaint, and therefore denies that the plaintiff is a corporation organized and existing under the laws of the State of Delaware and a citizen and resident of said State.

2. Defendant admits that it is a corporation organized and existing under the laws of the State of Pennsylvania and a resident of said State, having its principal office as alleged in the Bill of Complaint.

3. Defendant admits that on March 28, 1922, Letters Patent of the United States No. 1,411,231 were granted to Dovan Chemical Corporation, of Wilmington, Delaware, a corporation of Delaware as alleged assignee of Morris L. Weiss of Brooklyn, New York. But the defendant denies that Morris L. Weiss, a citizen of the United States of America, residing in Brooklyn, New York, was, prior to the 12th day of November, 1921, or at any other time, the first, sole, true and original inventor of certain new and useful improvements in vulcanization accelerators or any process of treating rubber or in a vulcanized rubber compound in which an accelerator is used; denies that the said alleged improvements were not known or used by others in this country and not patented or described in any printed publication in this or any foreign country before his alleged invention or discovery thereof, or more than two years prior to the filing of his application for Letters Patent of the United States therefor, and not in public use or on sale in this country for more than two years prior to the filing of his said application for Letters Patent therefor and not patented in any country foreign to the United States on an application filed by said Weiss or his legal representatives or assigns more than twelve months prior to his application for Letters Patent of the United States therefor, and that no application for a patent on said improvement had been filed by said Weiss or his representatives or assigns

in any country foreign to the United States; denies that on November 12, 1921, said Weiss duly made or on the 12th day of November, 1921, filed, an application for Letters Patent of the United States for said invention or improvement; denies that all of the provisions and requirements of the Statutes of the United States in such cases made and provided were duly complied with by the said Weiss; denies that the said application for the alleged inventions and improvements and discovery described, shown and claimed therein were duly assigned to the plaintiff; denies that said Letters Patent No. 1,411,231 were duly issued on said application and that the plaintiff was granted by said Letters Patent the exclusive right to make, use and vend the alleged inventions and improvements set forth, described and claimed in said Letters Patent throughout the United States and territories thereof; and the defendant denies each and every allegation contained in paragraphs 4 and 5 of the Bill of Complaint and not herein and hereby specifically admitted.

4. The defendant does not know, has not been informed save by the Bill of Complaint and therefore denies that by virtue of the premises referred to in the Bill of Complaint or otherwise the plaintiff became and ever since the issue of said patent on March 28, 1922, has been and now is the sole owner of the entire or any right, title and interest in said Letters Patent No. 1,411,231 and has been and now is entitled to sue for and collect all or any damages and profits for the infringement of said Letters Patent; and the defendant denies each and every allegation contained in paragraph 7 of the Bill of Complaint.

5. Defendant does not know, has not been informed save by the Bill of Complaint and therefore denies that the inventions and improvements of said Letters Patent No. 1,411,231 are of great or any value and importance to the plaintiff or that the plaintiff and its predecessor in business have caused quantities of the vulcanization accelerator described and claimed in said patent to be manufactured and sold to the public for use in the vulcanization of rubber and rubber goods, or that the plaintiff is prepared and able to supply the demand for said alleged inventions and improvements for such purposes or that the alleged inventions or improvements of said Letters Patent for such purposes are of great value, benefit, advantage and importance to the public, and that the public since the issue of said patent have with one or two exceptions generally accepted and acquiesced in the rights granted by said Letters Patent and the alleged rights of the plaintiff therein and thereunder; or that said Letters Patent have been especially acquiesced in by the plaintiff's licensee (exclusive except to plaintiff) which licensee well knowing the premises now acquiesces and always has acquiesced in said patent and has paid plaintiff in excess of Seventy-Five Thousand Dollars ($75,000) as royalties thereunder; or that except for the alleged infringement complained of and said exceptions the plaintiff would now be in undisputed possession, use and enjoyment of the alleged rights and privileges secured by said Letters Patent and in respect of the gains and profits from the same; and this defendant denies each and every allegation contained in paragraph 8 of the Bill of Complaint and states the fact to be that since the

grant of said Letters Patent No. 1,411,231 on March 28, 1922, the claims of the plaintiff thereunder have been generally disputed and defied throughout the portions of the rubber and chemical industries of the United States interested in the use of rubber accelerators and that in fact the plaintiff heretofore brought suit for alleged infringement of said Letters Patent and that thereupon said Letters Patent were judicially determined by the United States Circuit Court of Appeals for the Second Circuit to be invalid and void in the case entitled *Dovan Chemical Corporation vs. National Analine & Chemical Co.,* reported 292 Fed. Rep., 555.

6. The defendant does not know and has not been informed save by the Bill of Complaint as to any of the matters and things alleged in paragraph 9 of the Bill of Complaint and therefore denies each and every allegation contained in said paragraph 9 of said Bill of Complaint.

7. Defendant denies that it has infringed upon said Letters Patent No. 1,411,231 and specifically denies that since March 28, 1922, and prior to the execution of the Bill of Complaint herein it has unlawfully and wrongfully or otherwise without right or license under said patent or in violation and infringement thereof used, made, sold, and offered for sale within the United States and is now making, selling and offering for sale within the United States rubber and rubber products vulcanized with diphenylguanidine employing or embodying the alleged invention and improvements of said Letters Patent or substantial or vital parts thereof and has thereby infringed or contributed to the infringement by others of said Letters

Patent contrary to any rights of the plaintiff thereunder; and the defendant denies each and every allegation contained in paragraph 10 of the Bill of Complaint.

8. The defendant denies each and every allegation contained in paragraph 11 of the Bill of Complaint.

9. Defendant admits that prior to the commencement of this suit it was notified of the alleged rights of the plaintiff in said Letters Patent No. 1,411,231 and of the alleged infringement and threatened infringement thereof and warned to cease and desist from such alleged infringement; but the defendant denies each and every allegation of paragraph 12 of the Bill of Complaint not herein and hereby specifically admitted and states the fact to be that due consideration of the alleged invention and improvement described and claimed in said Letters Patent No. 1,411,231 referred to in said paragraph 12 of the Bill of Complaint led the defendant to the conviction that said Letters Patent were in all respects invalid and were considered to be invalid by those interested in the manufacture, sale and use of rubber accelerators and that upon investigation the defendant learned that said Letters patent had been judicially determined to be invalid and void by the United States Circuit Court of Appeals for the Second Circuit in the suit entitled *Dovan Chemical Corporation vs. National Analine & Chemical Co. Inc.,* reported 292 Fed. Rep., 555.

10. The defendant does not know and has not been informed save by the Bill of Complaint as to any of the matters and things alleged in paragraphs

13 and 14 of the Bill of Complaint, and therefore denies each and every allegation contained in said paragraphs 13 and 14 of the Bill of Complaint.

11. Defendant avers that said Letters Patent No. 1,411,231 were and are invalid and void because the alleged invention or inventions purporting to be patented thereby did not constitute patentable knowledge or invention within the meaning of the Patent Law in view of the prior state of the art and in view of what was common knowledge on the part of those skilled in the art at or prior to the date of the said alleged invention of the subject matter of the said Letters Patent by the said Morris L. Weiss.

12. Defendant further avers that long prior to the filing by the said Morris L. Weiss of the application for the said Letters Patent No. 1,411,231, and long prior to the presentation or announcement by the said Weiss of any claim that he was the first to discover or suggest that diphenylguanidine possessed any utility as a rubber accelerator, the value and utility of diphenylguanidine as a rubber accelerator had been publicly announced to those most interested in the use of rubber accelerators and knowledge thereof had been spread broadcast among chemists and manufacturers of rubber goods interested in the use of rubber accelerators, but no claim was made by the said Weiss or by any one in his behalf at that time or at any time thereafter for a long period of time that he the said Weiss, had been the first to appreciate the value of diphenylguanidine as a rubber accelerator or had conceived the idea of so using it at any time prior to the said announcement; furthermore, at various times thereafter, the use of diphenylguan-

idine as a rubber accelerator and the announcement of its value as a rubber accelerator, were discussed by the said Morris L. Weiss under conditions such that, had he then claimed to be the inventor of diphenylguanidine as a rubber accelerator, or to have been the first to suggest the use of diphenylguanidine as a rubber accelerator, he should have so stated, but nevertheless, while the said Weiss did claim that he had invented a process of making diphenylguanidine, at no time did he claim or suggest that he was the inventor or the first to suggest the use of diphenylguanidine as an accelerator; wherefore defendant avers that the said Weiss and the plaintiff herein are estopped from asserting that the said Letters Patent No. 1,411,231 are valid, that the said Weiss is the inventor of any inventions or improvements described in said Letters Patent or that the said Weiss was the first to conceive or to propose the use of or to use diphenylguanidine as a rubber acceleator.

13. Defendant avers that said Letters Patent No. 1,411,231 were and are invalid and void because the alleged invention and discoveries described and claimed therein, or all material and substantial parts thereof had been, prior to the alleged invention and discovery thereof by the said Morris L. Weiss, patented, described and published in the following Letters Patent, to wit:

U. S. Patent No. 1,159,257 to Georges North, granted Nov. 2, 1915.

U. S. Patent No. 1,159,258 to Georges North, granted Nov. 2, 1915.

U. S. Patent No. 1,371,662 to Clayton W. Bedford, granted Mar. 15, 1921 (appln. filed Jan. 6, 1917).

English Patent No. 130,857 of 1919 to North British Rubber Co.

French Patent No. 492,140 to The Goodyear Tire & Rubber Company. Pub. June 28, 1919.

and also in other United States and foreign Letters Patent now unknown to defendant, but which when known defendant prays leave by proper amendment to insert in this answer.

14. Defendant avers that said Letters Patent No. 1,411,231 were and are invalid and void because the alleged invention and discovery described and claimed therein, and all material and substantial parts thereof, had been, prior to the alleged invention and discovery thereof by the said Morris L. Weiss, or more than two years prior to his application for said Letters Patent, described and published in the following printed publication, to wit:

Chemical & Metallurgical Engineering, Oct. 1, 1919, Vol. 21, No. 7, page 430.

Journal of Industrial and Engineering Chemistry, April, 1920, Vol. 12, No. 4, pp. 317-324.

Journal of Industrial and Engineering Chemistry, February, 1921, p. 125.

India Rubber World, May 1, 1921, p. 572.

Indiana Rubber World, Nov. 1, 1919, pp. 80-81.

Le Caoutchouc et Gutta-percha, July 15, 1919, pp. 9853, 9858, 9860-9864.

Le Caoutchouc et Gutta-percha, Sept. 15, 1918, No. 175, pp. 9609-9611, 9637-9638.

Le Caoutchouc et Gutta-percha, Nov. 15, 1919, Vol. 16, No. 189, p. 10050, p. 10051.

Le Caoutchouc et Gutta-percha, ..., 1921, Vol. 18, p. 11009.

and in various other publications now unknown to this defendant but which when known defendant prays leave by proper amendment to insert in this answer.

15. Defendant avers that said Letters Patent No. 1,411,231 were and are invalid and void because the said Morris L. Weiss was not the original and first inventor or discoverer of the alleged invention or inventions purporting to be patented in and by said Letters Patent but that the same and every material part thereof were, prior to the alleged invention thereof by the said Morris L. Weiss, invented, if there be any patentable invention therein, by or known to and used by the following named persons at the places set opposite their respective names, such persons now residing, to the best of defendant's knowledge and belief, at the places stated:

Carl H. Eaton, of Youngstown, Ohio, at Youngstown, Ohio.

George D. Kratz, of Cuyahoga Falls, Ohio, at Norwalk, Connecticut and Cuyahoga Falls, Ohio.

A. H. Flower of Cuyahoga Falls, Ohio, at Cuyahoga Falls, Ohio.

The Falls Rubber Company, Cuyahoga Falls, Ohio.

Cole Coolidge of Columbus, Ohio, at Cuyahoga Falls, Ohio.

Ralph W. Baldwin, Youngstown, Ohio.

Republic Rubber Co., Youngstown, Ohio

and by other persons whose names and residences are not at present known to defendant but which, when ascertained, it prays leave by proper amendment to insert in this answer.

16. Defendant avers that at the time of filing the application for the said Letters Patent No. 1,411,231, and during the pendency thereof in the United States Patent Office, the said Morris L. Weiss misrepresented and made false and misleading presentations of his alleged invention and of alleged facts in connection therewith to the Commissioner of Patents with intent to surreptitiously and unjustly procure the grant of and acquire the said Letters Patent and that the said Letters Patent No. 1,411,231 are therefore invalid and void.

WHEREFORE, defendant prays that the Bill of Complaint be dismissed with costs.

PENNIE, DAVIS, MARVIN & EDMONDS,
Solicitors for Defendant.

DEAN S. EDMONDS,
Of Counsel.

RECORD.

IN THE
DISTRICT COURT OF THE UNITED STATES
FOR THE WESTERN DISTRICT OF PENNSYLVANIA.

DOVAN CHEMICAL CORPORATION,
Plaintiff,
vs.
CORONA CORD TIRE COMPANY,
Defendant.

In Equity,
No. 1109.

And now, Wednesday, October 7, 1925, the above cause came on to be heard before Hon. ROBERT M. GIBSON, J., at Pittsburgh, Pa.

APPEARANCES:
J. J. KENNEDY, Esq.,
J. S. WOOSTER, Esq.,
Messrs. BYRNES, STEBBINS & PARMELEE,
For Plaintiff.
DEAN S. EDMONDS, Esq.,
FRANK E. BARROWS, Esq.,
Messrs. WINTER, BROWN & CRITCHLOW,
For Defendant.

Opening Statement of Plaintiff.

By Mr. Kennedy:

This is a patent suit, and the charge in the Bill is infringement of the patent, and the prayer of the Bill is for the usual injunctive relief and also for the recovery of damages and profits.

The plaintiff is a New York corporation, and the defendant is a corporation of Pennsylvania, doing business at East Butler, where it manufactures and sells tires for automobiles and possibly other products.

I will make a brief statement concerning the invention of the patent in suit. I would like to make a statement which I think will be useful to the Court, for the purpose of making it clear, as to just what the status of this patent is in the rubber industry. In most developed industries there are various ways of doing different things, and various ways of doing the same thing. That is true of the rubber industry, as it is other industries. In some of those developed arts we now and then run across a patent which is so broad and of such a pioneer character that it dominates the whole field; in other words, it includes within its monopoly all of the various ways of doing a certain thing. On the other hand, and very frequently, we run across patents that are limited to some specific way of doing some specific thing. Now, this patent that I am going to briefly describe to your Honor at present, is in between those two kinds of patents. In other words, it relates to a certain field which it created itself, and beyond which it does

not go, but in which it includes everything that probably belongs in that field. So, that so far as the rubber industry, and so far as it is concerned with things like those described in this patent, it is not affected by this patent to the extent of being prevented from doing things for say the same general purpose as the things in this patent are designed to do.

This patent, as I say, relates to rubber compounds and to processes of producing them. It has to do primarily with the vulcanizing of compounds, and therefore, with hard and semi-hard products. The vulcanizing of rubber began, according to my information, about eighty years ago, and the only vulcanizing agent then was sulphur. The vulcanizing agent today is sulphur. In other words, the vulcanizing agent in the rubber industry for producing hard or semi-hard rubber products, has throughout those eighty years been sulphur. Now, in the vulcanization of rubber compounds, a substantial amount of time is consumed. When I say "substantial", I mean from the point of view of the manufacturer, to whom the time consumed in operation is of course a very important element. Some ten years ago, or thereabouts, the manufacturers and others skilled in the rubber art turned their attention towards the acceleration or speeding up of this vulcanizing process. That was, I believe, the result to some extent, but not the entire extent, of the extension in rubber manufacture to the production of tires for automobiles, which, as your Honor probably knows, wear out rather rapidly, and often too rapidly. So that there is a constant big demand for rubber tires and has been for several years past. So that, so far as rubber tires are concerned, this is

true also as to other things—the element of time in vulcanization was important. Now, prior to the time that the patentee here made the invention covered by this patent, others had produced and there were used, and there are used now, what are known as accelerators, that is to say, something added to the rubber compound which had the effect of hastening or shortening the period of vulcanization. At that time, that is to say, prior to the invention of the patent here, there was a substance known as triphenylguanidine, and there were others, but I refer to that particularly because it is referred to specifically in the patent in suit. Now, these chemists and others who turned their attention towards these accelerators, had not simply the problem of acceleration to solve, but in solving it had also to see to it that in employing something for the purpose of acceleration they did not impair the quality of the product. In other words, you have rubber products of a certain design, or require a certain quality, and you want to hasten the time of vulcanization, and therefore the time of production, and therefore cheapen the cost, it will not do merely to have something that will accelerate, because you might have something which, while it did accelerate, would impair the quality of the product. I go into that because it is necessary for me to do so in order to make the situation clear, or at least as clear as I can, to your Honor before we start in with the trial of his case.

Now, about 1918 the inventor of the patent here in suit, entered the field then and thereafter made experiments, not simply for the purpose of producing an accelerator, because they were known, but for the

purpose of improving rubber products, and in doing so used something which would also accelerate the process of vulcanization. He experimented in 1918 with a large number of different things that occurred to him, as in the case with any chemist, and he finally hit upon the subject matter of this patent, which I will presently describe. Those experiments or tests of his resulted in the adoption by him as the best thing for his purposes, the improvement of the product and acceleration of vulcanization. Certain substances that accelerated are present in his patent, to which I will presently refer. Before referring, however, to his patent, and what is described in it, I should add that as early as the early part of 1919, this patentee had reached the point in his tests and experiments, which had extended over months, where he was satisfied and certain that this material of his would not only answer his purposes but were better than other material in the way of accelerators then on the market. He was then working for the Republic Rubber Works of Youngstown, Ohio, working there on a salary. I might say his age now is thirty-eight; then it was thirty-one or thirty. He had a wife and I believe a child, and was working simply for his salary. The Republic Works went out of business because of financial difficulties, and as a result, this man lost his job, having no means of support and having respossibilities in the way of a wife and child. He endeavored to get others interested in his invention, and in the effort to so interest them, he naturally first visited the rubber manufacturers, that is to say, some manufacturers who manufactured all kinds of rubber articles. He did not meet with any success

there, and then in the spring of 1920 he went to New York and approached a different class of prospects, namely, manufacturing chemists. The reason or one reason for his failure to interest rubber manufacturers probably was that if they took up this invention of his it would necessitate the installation of a plant by them for its manufacture. Probably also that was the reason for going to manufacturing chemists, with the idea that if he could get them interested then his material would be manufactured by these manufacturing chemists and be available to the rubber manufacturer, who therefore would not have the necessity of having to have an equipment for its manufacture. Now, his problem was not concerned simply with the discovery of this accelerator. I use that term for brevity. He was also concerned with the development of a process for the manufacture of this material. There were at the time when he was investigating and testing these different things that occurred to him, no laboratory methods for manufacturing this material. He spent a great deal of time, and profitably, I believe, so far as results were concerned, in the development of a practical quantity and a process for the manufacture of this material. When he came from New York—I should have said that after trying several of those manufacturing chemists, he wound up with the gentlemen who are here present, Mr. Woodward and Mr. Doty, and interested them and showed them that he had what he pretended to have, and going ahead with the manufacture and sale of this material. I am not referring here to this statement, and I shall not refer to it. It will not be a matter of proof. In other words, I am not indulging

in anything in the shape of argument, but am making a statement of things which we expect to prove here. Woodward and Doty took this up under an arrangement with the patentee, which has continued down to the present time. So that, although the patent is now owned by the plaintiff here, which is a corporation, the personnel of that corporation, so far as a large ownership of stock is concerned, includes not only Woodward but also this patentee Weiss.

Now, coming to the patent itself. What Weiss discovered and had a conception of in 1918, and perfected in the early part of 1919, so far as demonstration of its utility for his purpose is concerned, was that di-substituted guanidines of a certain kind or class, of which diphenylguanidine is a member or type, would be useful and were useful, not only for the improvement of the product but also in the acceleration of its vulcanization. In referring to these diguanidines, and more particularly the representative diguanidines, he, for the purpose of making it clear as to what he had accomplished, referred, for the purpose of comparison, to triphenylguanidine, which was then a known accelerator, and he says in the patent as to the result of the use of diphenylguanidine, the following:

> "I have found that diphenylguandine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but results in a final product much superior in texture, strength, durability and aging qualities over that when the

triphenylguandine is used. A greatly improved product also results when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards elasticity, aging qualities and freedom from 'bloom'. In these and similar instances, it has been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressure than those commonly employed."

What is his statement in the specification of the patent? It is, as I understand it, based not only upon the personal observation of Weiss himself, but upon the experiences of others actually engaged in the manufacture of rubber compounds and rubber products in the production of which was used an accelerator. Now this patent, like most other patents, has a number of claims, and the courts have so frequently referred in a critical way, and properly so, to the unnecessary number of claims, that we, for the purpose of simplifying this case for the Court and also for counsel, and in so simplifying it and endeavoring so far as plaintiff is concerned and as to that, the defendant may speak for itself—notified defendant's counsel that so far as reference to the particular claims is concerned, in the trial of this suit, we would refer to and consider in our proofs only Claims 5 and 8, which delate to the process of the patent, and Claims 9 and 12, which relate to the product of rubber compounds. The consideration of those claims will render unnecessary a consideration of other

claims, and therefore, consideration of those claims by the plaintiff and by the defendant will be all that is necessary, from my point of view, for the purpose of this trial, which would be fair to both parties.

Now, as to the question of infringement, counsel for defendant has entered into the usual stipulation, in which in this particular case it is stipulated that the defendant has used rubber compounds containing diphenylguanidine, which is, as I have stated before, the preferred accelerator, so-called, in the Weiss patent in suit, and as I have also stated before, an example or representative of the group of accelerators more generally stated in the patent or named in the patent, is di-substituted guanidine. The phenyl in diphenylguanidine is one radical quality, and the diphenyl represents the substitution of two phenyl radicals for two hydrogen elements of guanidine. Now, in the case of other radicals, the name would be di-something else, so the di-substitutes include diphenylguanidines and other guanidines which it is not necessary to name here.

Now, this patent was in litigation between this plaintiff and the National Aniline Company, and that case was tried in the United States District Court for the Southern District of New York, before his Honor, Judge Manton, who was then a Circuit Judge but at that time sat in the District Court. He decided in favor of the patentee, and also in favor of the plaintiff, on the issue of infringement. An appeal was taken by the defendant to the United States Circuit Court of Appeals and heard by Circuit Judges Rogers and Hough and Mayer. In the course of time an opinion was handed down by Judge Hough, in which

Judge Rogers concurred, holding that there was no invention in the patent in suit, but Judge Mayer dissented from that opinion. So that we are here before your Honor with a decision in one court in our favor by a Circuit Judge sitting in the District Court, and a decision against us by the majority in the Court of Appeals, and also in the position of having decisions in our favor by two Circuit Judges, namely, Judge Manton and Judge Mayer, and a decision against us by two other Circuit Judges, Rogers and Hough. Judge Hough, who wrote the opinion—I say this with the utmost respect and great admiration for Judge Hough—was mistaken in his views of the situation as presented by the testimony in that case. Possibly he was not to blame for that, and no doubt he was not, but I should hestitate to come before your Honor with this case, if the testimony in it was going to be the same as that in the National Aniline case, because I realize that while the decision in that case by the Appellate Court, while it may be persuasive, is not conclusive upon this Court, still, the disposition of the Court under the rule of county would be to follow that decision, if the facts here were the same as then; but we will have testimony here, some of which I have referred to, connected mainly with the tests, researches and investigation of this man Weiss before he finally made his invention, which was not before the Court in the National Aniline case, or, if before it at all, was only before it in the most general way, without any proper presentation as to detail. In that respect, and in others, the record here for the plaintiff will be radically, materially, different from that before the Court in the National Aninline case, and

such that if it had been before the Court, it would undoubtedly have led to a different decision.

That is all, your Honor, that I think it is necessary to say.

Just one thing I neglected to refer to and what we intend to prove in our case. I did not finish my story as to the history of this invention, because I omitted to say that after Weiss had associated himself with Woodward and Doty, they began, as soon as they could make an impression upon the trade, to manufacture and sell this material, and that since then they have built up a large and growing business in dollars and cents. Also, I believe the testimony will show that one of the biggest manufacturing chemists in the United States, has taken a license under that patent and under that license has paid thousands of dollars.

PLAINTIFF'S CASE.

By Mr. Wooster:

We offer in evidence a stipulation as to the facts of ownership of the patent, the incorporation of the plaintiff and the defendant, and the use by the defendant of diphenylguanidine, a copy of which is as follows:

> "It is hereby stipulated and agreed by the parties hereto, by their respective counsel, as follows:
>
> The Weiss patent, No. 1,411,231, of which infringement is charged in this suit, is the patent of which infringement was claimed in a suit in

the United States District Court for the Southern District of New York, brought by this plaintiff, Dovan Chemical Corporation, against National Aniline & Chemical Co., Inc. That suit was tried in open court before Circuit Judge Manton in January, 1923, and resulted in a decree sustaining the patent and holding it to have been infringed. On appeal decided in July, 1923, said decree was reversed by majority decision of the United States Circuit Court of Appeals for the Second Circuit, whose opinion is recorded in 292 Fed. Rep. 555, Circuit Judge Mayer dissenting therefrom without opinion.

As counsel for the parties to this suit wish to introduce in this suit many matters which were introduced in the National Aniline suit, this stipulation respecting a stipulation respecting a portion of defendant's case are entered into for the purpose of saving the time and expense incident to the introduction of formal proof.

Printed copies of United States and foreign patents, including dates printed thereon, and photographic copies prepared from such printed copies, may be offered by either party and shall be received in evidence with the same force and effect as the originals thereof, subject to correction should error appear.

It is conceded by defendant that the parties to this suit are corporations, as alleged in the bill of complaint; that plaintiff is and has been since its issue the owner of the patent in suit; and that subsequent to March 28, 1922, and prior to the filing of the bill of complaint herein, defendant

purchased diphenylguanidine for its own use, and used it at its place of business at East Butler, Pennsylvania, in the proportion of close to 2/3 of 1% on the rubber, as an accelerator in the vulcanization of rubber, the vulcanizing agent being sulphur, and sold rubber products including tire casings so vulcanized.

Plaintiff states that at the trial of this cause it will rely on all claims of the Weiss patent in suit but will only particularly refer to Claims 5, 8, 9 and 12 thereof.

Dated June 3, 1925.

(Signed) J. S. WOOSTER,
Counsel for Plaintiff.

PENNIE, DAVIS, MARVIN & DAVIS,
Counsel for Defendant."

Plaintiff's Testimony.

DR. GEORGE STAFFORD WHITBY, a witness called on behalf of the plaintiff, having been duly sworn, testified as follows:

By Mr. Wooster:

I offer in evidence a printed copy of U. S. Patent to Weiss, No. 1,411,231, issued March 28, 1922, to the Dovan Chemical Corporation, and I ask that the same be marked Plaintiff's Exhibit No. 1, Patent in Suit.

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. Will you please state your name, age, residence and occupation?

A. George Stafford Whitby, age thirty-eight, residence Montreal, Canada; Professor of Organic Chemistry at McGill University.

2. Q. Please state what your education and experience has been, qualifying you to testify in relation to chemical subjects, and particularly subjects relating to the qualities, compounding, vulcanizing and testing of rubber.

By Mr. Edmonds:

We will concede that Dr. Whitby is qualified to testify here, although I would like to have a brief specification of his connections, and so forth.

A. My educational qualifications are: For a time an associate of the Royal College of Science, London, England; Bachelor of Science with class honors in Chemistry, University of London; Doctor of Philosophy with the silver medal for research work in ; a Fellow of the Royal Society of Canada. I have been engaged in rubber research, industrial and scientific, continuously for the past fifteen years; for seven years as chief chemist to a large group of rubber-producing companies, and subsequently have been considerably engaged in rubber consulting work. I have published some twenty or twenty-five scientific articles dealing with rubber, several of them on the subject of accelerators. I am the author of a book entitled "Plantation Rubber and the Testing of Rubber," and am a member of the Committee of Chemists of the National Research Council of Canada. I am a member of the Crude Rubber Testing Committee of the American Chemical Society, and editor of the Rubber Section

of the International Critical Tables, published by the National Research Council at Washington.

3. Q. Are you at present on the staff retained by any organizations or companies having to do with rubber chemicals or rubber manufacture?

A. Yes. I am consulting chemist for one of the largest rubber manufacturing concerns in this country, and also for one of the largest manufacturers of rubber chemicals.

4. Q. Please state if you have read and understand the invention described in the patent in suit to Weiss, No. 1,411,231, and particularly as claimed in Claims 5, 8, 9 and 12?

A. Yes.

5. Q. For the benefit of the Court, will you please explain briefly the history and general processes of rubber vulcanization, including the use of substances for accelerating, the cure or improving of the product, particularly the organic substances, and state the nature, the characteristics and functions of diphenylguanidine, as set forth in the patent?

A. In order to convert raw rubber, which in its raw crude state has comparitively little use in the arts, into a material of very much greater value, it is subjected to a process known as vulcanizing, which is the fundamental process in all rubber manufacture, and consists essentially in mixing the rubber with sulphur—that is the most practical form— and then heating the mixture. The effect of this treatment is to improve tremendously the qualities that we describe in a particular kind of way as the elasticity of the rubber and other properties too. Even from the very earliest days of rubber manufacture, substances which

would hasten the process of vulcanization have been known. They were all of an inorganic character, such as lime, and so forth, but during the present century, materials of an organic character have been found, which will bring about this increase in the rate of vulcanization. Now, I think I should explain that this term "accelerator" carries with it a certain amount of ambiguity. On its face, one would naturally take it to mean merely an increase in the speed of vulcanization, but undoubtedly the substances that we for convenience refer to as accelerators are capable, some to a greater extent than others, of producing many beneficial effects in the quality of the product, in addition to increasing the rate of vulcanization. So that there is this unfortunate ambiguity attached to the term, which really has a wider significance than might at first appear. The patent claims the use of disubstitutedguanidines, and mentions in particular the use of diphenylguanidines, diarylsubstitutedguanidines, producing an improvement of the qualities of the product, and one has a second object, according to the patent itself, the increasing of the speed of vulcanization. Now, the aspects in which it does improve, or is claimed to improve, the quality, are several. It improves the strength, it is stated to improve the strength of the rubber and also its texture. Now, those two matters might be considered together, and would perhaps be included under the more general term of elasticity. By the strength I mean the amount of force which is required to pull a rubber in order to rupture it, to break it. By the texture we mean various qualities, but perhaps particularly the toughness, the amount of force which is required to stretch the

rubber to something short of the point of rupture. I think that is perhaps the best measure of toughness and these qualities, an improvement in the strength and toughness would undoubtedly result in a rubber with better wearing qualities, better resistance to abrasion when applied, for instance, in a tire tread, better resistance to tearing, and in general better wearing qualities. Furthermore, I think one should recognize, too, that a substance which is called for convenience an accelerator which is capable of bringing about improvements in the quality of the rubber would enable a rubber compound—I should explain that it is very seldom that rubber and sulphur are used alone; they are almost invariably mixed with a variety of powders, in order to get the requisite properties. I was going to point out that an improvement in the strength and in the toughness would enable you to secure a given result in your ultimate product with cheaper powders, less than would be required in the absence of an accelerator, if it were not able to attain this extra toughness and strength. Then again it is a very serious defect in a rubber article, this rapid, unduly rapid depreciation with age. That is a matter that has always been kept in mind in manufacturing rubber goods. It is claimed in this patent that the use of diphenylguanidine and other disubstitutedguanidines as accelerators diminish the tendency of rubber goods to undergo depreciation on keeping. There are other respects, other connections, in which diphenylguanidine produces advantageous results, other than merely hastening vulcanization. I think in order to bring those out, perhaps one would have to institute some sort of comparison be-

tween diphenylguanidines and the materials that were available as accelerators at the time it was discovered. Perhaps I ought not to go into such a long comparison, but I may say that after having considered carefully diphenylguanidine in comparison with the accelerators that were available, commercially available, at the date this accelerator was discovered, that I can see no other accelerator, none commercial at that time, that approached diphenylguanidine in regard to the collection of advantages which it displayed. There may have been an accelerator here that was as good as diphenylguanidine in one respect, and one here that was as good in some other respects, but for a collection of advantages in one substance, I think undoubtedly diphenylguanidine presented a very great advance on anything in commercial use at the time. It had various advantages as a commercial matter, aside from those advantages affected in vulcanization, advantages which no other accelerator I think available at that time possessed in the same measure. It was, for instance, not poisonous; toxic character was a decided drawback attaching to many of the accelerators known at that time. It was not soluble in water, and therefore could be used with safety when vulcanizing the rubber goods with open steam, as vulcanization is often carried out by that method. Heat is applied by open steam. But it was soluble in the rubber, which was a valuable quality, dispersing it uniformly in the rubber. Furthermore, in addition to not being toxic, it was stable; it could be kept indefinitely. Whereas, some of the substances available at that time were not stable. It doesn't have any tendency to take up water when you expose it to the air, which was a defect at

that time. Furthermore, it is a powder, and is very agreeable on that account to the rubber compounder. It is a fine powder and it is a definite substance, with a definite melting point, and is very easy to check on its purity; and such features as those I have mentioned give it more definite advantages as a chemical. Then again it didn't suffer from the disadvantage of producing discoloration in rubber goods, which some of the accelerators known at that time did. It is an excellent accelerator to maintain a white color in a product. I don't know that I should elaborate any further on this advantageous effect on the physical properties or elastic properties of the rubber, but perhaps just one other point in that connection I might mention. I should explain that in vulcanizing, mixing a given amount of sulphur with the rubber, if you increase the period through which you heat this mixture, and if you increase the vulcanization further, the material cools off and tends to become brittle. You have to choose this optimum point in choosing vulcanizing conditions for chemical operation. Now, it is obviously an advantage that this optimum point should not be too sharp; that is to say, you should not be able to begin to drop down into a brittle character too quickly. If there was any slight error in the mill operations, it is liable to produce a bad quality of rubber, so it is a distinct advantage to have a rather long period at times over which you can still get substantially optimum qualities and the diphenylguanidines and the disubstitutedguanidines particularly have an advantage from that point. They give this rather long period of vulcanizing time over which you are still getting good results. That quality

is usually called flat curing. But it is obvious that its presence is going to give you a more fool-proof rubber mixture than you would get in its absence. Furthermore, in some cases it is considered desirable to leave no free sulphur in the compound with the rubber at the end of the vulcanizing period, or at least substantially not. If any free sulphur is left, that will come out in the form of fine crystals on the rubber goods, and has that familiar shiny appearance. That appearance of sulphur is called bloom. In some cases it is desired not to have a blooming character of rubber goods. That of course means essentially that you must not have any very great amount of free sulphur left when you finish your vulcanizing heating. I think undoubtedly the use of disubstituted-guanidines as accelerators assists the attainment of such a non-blooming, because they will allow you to use a comparatively small amount of sulphur and drives the vulcanizing forward so as to get optimum results, and get quality in your product with such a small amount, and leaving very little free sulphur, and therefore resulting in the absence of bloom in the finished product. I think one might say that a really desirable accelerator should be considered not merely as hastening the speed, shortening the time in which you have to heat your rubber, but increasing the vigor of this vulcanizing reaction; so it pushes it home and gives you an improved result in the product as well as shortening the time through which you have to heat the mixture.

I was trying particularly, I think, to emphasize the fact that this term "accelerator" really has a broader significance than might appear on the surface, and one has to take into consideration the effect of the material and the qualities of the product, as well as the period of time in which you have to heat your rubber.

6. Q. Will you explain generally the various operations that rubber goes through from the crude rubber and the fillers and other things put in with it, until the finished goods is rendered; that is to say, explain generally milling, sheeting, curing and those terms, and just where the accelerator has any function in those various operations?

A. Stating the process of rubber manufacture in a fairly general way, the raw rubber, which is too hard in its original condition, is worked on a mill, the rolls of which are heated, and as a result of mechanical working and the heat, it is rendered plastic, comparatively plastic. Then there is incorporated into it this plastic material, plastic gum, sulphur, which is the essential vulcanizing agent usually, a variety of powders which have definitely advantageous effects, especially when the rubber has to be subjected to abrasive wear, as in the case of a tire tread, and if an accelerator is to be used, that too is usually incorporated at this stage. Quite a variety of mixtures are made, but they always contain sulphur as the vulcanizing agent, and very generally today an accelerator. This mixture having been made as uniform as possible is then converted into suitable

shapes. Quite frequently it is put through a calender consisting of three rolls vertically arranged, and passes through the first two and then the bottom and in that way is converted into a sheet which is comparatively plastic in this stage. From such sheets the greater part of rubber articles are built up in one way or another. The building operation of course depends upon the article, whether hot water bottle or a tire, or whatever it may be. Then this mixture having been made up, is then subjected to heat in some convenient way. The exact way depends largely upon the nature of the goods you are making. If you are making a tire, you put your made up tire in a heavy form, and press the two portions of the form together, and usually subject that to steam at a temperature corresponding to about 40 pounds of steam pressure, something of that order. If you are making rubber tubing, you may not have your material in the form, but just let it loose in a soapstone and again use steam. In certain cases you apply the heat in the form merely of hot air, if making footwear; but in all cases the essential features are that you have a mixture of rubber with various powders as a rule, with sulphur and usually with an accelerator, and you then shape that into the article you wish to make, and heat it. Those are the essential features of the preparation of vulcanized rubber.

7. Q. During the milling and calendering, is it desirable that the accelerator be active or inactive?

A. It is very undesirable that the accelerator

should show any activity at the temperatures that prevail during milling.

8. Q. Why is that?

A. Otherwise it would start the vulcanizing process, begin to be active at these temperatures, and your rubber would begin to stiffen up, become what is technically called scorched.

9. Q. As triphenylguanidine is mentioned in one patent in suit, will you briefly compare it with disubstitutedguanidines, and particularly diphenylguanidine, as mentioned in the patent in suit?

A. I think that one can merely say that undoubtedly diphenylguanidine is a very active accelerator; not merely does it increase the speed of vulcanization to a much greater extent than does a similar amount of triphenylguanidine, but it gives very much improved physical properties in the product, the elastic properties. strength, and so forth, to which I previously referred.

10. Q. It is stipulated as a fact in this case that the defendant used diphenylguanidine in the proportion of close to two-thirds of one per cent on the rubber, as an accelerator in the vulcanization of rubber, the vulcanizing agent being sulphur. Do you understand what is meant by that?

A. Yes.

11. Q. Will you please compare that stipulation of use by defendant with Claims 5, 8, 9 and 12 of the patent in suit, and state whether or not you find the subject matter of such claims embodied in that stipulated use?

By Mr. Edmonds:

I do not think this is a proper question. I do not know just what Your Honor's practice is, but I don't see how the statement of this witness in that regard can be of any service to the Court.

By the Court:

What is the nature of this proof you propose to put in?

By Mr. Wooster:

The stipulation is not in exactly the words of the claim, and the claim perhaps, to the mind of the Court, may be not clearly understood on its face; and the purpose of this question is to have the testimony of this witness that the language as stated in these claims does mean what is stipulated in that formula as used by the defendant. Perhaps another way of reaching the same end would be to have this witness compare the formula as stipulated by the defendant with what is disclosed in the patent, not referring to any particular claim, and particularly the specific formula that commences at line 98, page 1, of the patent.

By the Court:

I think you may go ahead with that. This is merely a line of explanation, as I get it. It is not the passing of the witness upon the issues.

By Mr. Edmonds:

The question might just as well have been, "Does this defendant infringe?" The question means that and nothing else.

By the Court:

It is not our purpose to allow that. It is merely, as I understand it, an explanation. Of course, I think it is improper, because that would be the duty of the Court to determine, and not by the witness to express an opinion; but assuming it is not that, I will overrule the objection.

(Question read).

A. Yes.

By Mr. Wooster:

12. Q. Will you compare the formula as used by the defendant with the disclosure of the patent, and particularly the specific example given at lines 98-102, page 1, of the patent in suit, and state what, if any, difference you find therein.

A. Comparing it with the example given on the lines of the place mentioned, I find that this stipulated condition does not include the use of any zinc oxide along with the rubber; but in comparing it with the disclosure of the patent in general, I believe that those conditions are covered by the patent —the stipulated conditions are covered by the patent.

13. Q. State whether or not the advantages of diphenylquanidine as an accelerator, as understood by you, are or are not attained by the formula stipulated by the defendant?

A. Yes, I would say so, speaking broadly.

CROSS-EXAMINATION.

By Mr. Barrows:

X14. Q. When did you first learn that diphenylguanidine was a rubber accelerator?

A. I couldn't say.

X15. Q. You have no recollection?

A. I have no recollection, no.

16X. Q. Do you think it was shortly after the paper was read by Dr. Kratz in September, 1919?

By Mr. Wooster:

Nothing about Dr. Kratz was mentioned in the direct examination.

By the Court:

The general assumption is perfectly correct. It is true it might be possible that there is a misunderstanding. Perhaps what ought to be asked first as far as the understanding of the witness is concerned, is whether he knows of such a paper, and whether it has ever been called to his attention. Of course, there is an assumption of his knowledge, which does not appear in the testimony as yet.

By Mr. Barrows:

X17. Q. Do you recall that you knew about diphenylguanidine prior to September, 1919, as a rubber accelerator?

A. No.

X18. Q. Does the letter that I hand you refresh your recollection as to when you did first learn of diphenylguanidine as a rubber accelerator?

By Mr. Kennedy:

I object to the inquiry, on the ground that the question, as I understand it, asks this witness as to when he first learned of the use of diphenylguanidine as an accelerator. For the purpose of refreshing his recollection, as I understand it, he is shown a letter. That letter, according to my reading of it, has nothing whatever to do with the use of diphenylguanidine as an accelerator, but it has to do with a matter of defense, which should go into defendant's case and not be injected into the plaintiff's *prima facia* case.

By the Court:

He is not offering that letter. This is only, as I understand it, shown him, and he is asked the simple question as to whether that refreshes his recollection. The answer then is simply yes or no, I take it. However, the question may have gone beyond that.

By Mr. Barrows:

The witness has testified at great length as to diphenylguanidine, and I think I am entitled to cross-examine him on that.

By the Court:

The offering of it might be objectionable at this time, but for the mere use that it is put, I cannot see that it is improper.

(Question read).

A. I see from this letter that I must have read the extract of a paper by Kratz.

By Mr. Wooster:

I would suggest the witness be instructed to answer yes or no, and not state the contents of the paper.

By the Court:

That is perhaps not responsive to the question. The answer should be yes or no.

A. Yes.

By Mr. Barrows:

X19. Q. Can you now tell me when you first learned that diphenylguanidine was a rubber accelerator?

A. I think that I must have seen the abstract of the paper by Mr. Kratz.

By Mr. Wooster:

Objected to as not responsive.

A. My recollection is that Mr. Kratz mentioned the fact in his—

By Mr. Kennedy:

Objected to as also irresponsive. He is getting things into the case that are not to go into it.

By the Court:

Yes, that is quite true. You are just asked to give the date. You may have got it in a particular way, perhaps by means of a particular paper, and you are simply asked the date of that paper.

A. I believe that was around in October, 1919.

By Mr. Barrows:

X20. Q. Where did you learn that diphenylguanidine was a rubber accelerator?

By Mr. Kennedy:

Objected to as immaterial.

By Mr. Barrows:

I said where.

By the Court:

All right.

A. I presume from the abstract of Mr. Kratz's paper.

By Mr. Kennedy:

Objected to as not responsive to the question. The question is, where did he learn it, which means, where was he when he learned it.

By the Court:

Yes, it is a mere matter of locality. Of course, if you understand what he means by that, you may so state.

A. From an abstract of Mr. Kratz's paper.

By Mr. Kennedy:

Objected to as irresponsive and volunteered. Also, I move to strike out the answer on that ground, and on the further ground that now the defendant is obviously attempting to interject into the plaintiff's *prima facie* case a matter which, according to their own opening statement, is a matter of defense, and as to that, if they persist in the inquiry, they should be compelled to make the witness their own.

By the Court:

They ought not to introduce their defense in cross-examination, but at the same time they have a right, if they desire, to test the qualities of a witness as an expert. They have a right to bring out that particular knowledge. The only thing I would say to counsel in that regard is that I would unquestionably admit the evidence along that line for that particular purpose, if you have not placed upon the record an admission as to his qualifications.

By Mr. Edmonds:

We admitted that he was qualified as to the general subject of rubber.

By Mr. Kennedy:

In the direct examination of this witness, the witness stated that he was familiar with the use of accelerators, and he may have said particularly diphenylguanidine and other things, I don't recall, but what he did testify to was that he was familiar with the use. What they are confronting him with now is not when did he first learn of, or become familiar with, the use of diphenylguanidine, but where he got his first information as to diphenylguanidine as an accelerator, and when he got it. That is part of their defense. It is no part of the plaintiff's case on direct or cross-examination. We are not disposed to keep anything out of this case which would give the Court light. We know this defense is going in, and we are prepared to meet it, but

we should not be compelled to meet it on our *prima facie* case.

By Mr. Barrows:

I think I am entitled to find out on what basis he makes these assertions, and to find out where he got the information.

By the Court:

I am disposed to allow you to go ahead on your cross-examination, as to the test of his knowledge as a witness. As to the ultimate effect on the case, that would be another proposition. I will overrule the objection at this time and note an exception to plaintiff.

By Mr. Kennedy:

But if Your Honor does permit them to go into this, which is obviously a matter of defense, it is within your province to reserve for the plaintiff here, and I should think your Honor should reserve to the plaintiff here, the right to deal with this as with other defenses in their rebuttal proof, instead of compelling the plaintiff to deal with it in their *prima facie* case.

By the Court:

I have so indicated, that I was not considering that feature at this time, but will subsequently take it up when we find out what the extent of the development here is.

By Mr. Kennedy:

May I have a running objection without repetition, to this line?

By the Court:

Certainly.

By Mr. Barrows:

X21. Q. From what source did you learn, in October, 1919, that diphenylguanidine was a rubber accelerator?

A. From an abstract of the paper by Messrs. Kratz, Flower and Coolidge.

X22. Q. You saw it about that time?

A. I presume so, yes.

X23. Q. You referred in your direct examination to a book which you had written. This book, I believe, is entitled "Plantation Rubber and the Testing of Rubber," one of the monographs on industrial chemistry, published in 1920, by Longmans, Green & Company. This is the book, is it not?

A. Yes.

By Mr. Barrows:

Will you agree, Mr. Wooster, that either side may refer to this book without putting it in evidence?

By Mr. Wooster:

Yes.

By Mr. Barrow:

X24. Q. On pages 106 and 107 of this book, there is a heading, "Natural and Artificial Accelerators," and on page 197 you give a list which you say is not exhaustive of substances that have been found effective as organic accelerators, and group 4 in this list is entitled "Urea, Thiourea, Guanidine Derivatives." Do you recall what guanidine deriva-

tives you were familiar with at the time you wrote this book?

A. No. I have no very clear recollection, but I imagine that I had the information mentioned, at least, in that abstract.

X25. Q. Possibly the original paper?

A. Quite possible, yes.

X26. Q. In fact, the original paper is referred to in a footnote on that same page?

A. Yes, that is so.

X27. Q. And this original paper is in a footnote headed "For literature on the subject of accelerators, see so-and-so," and the last paper is the paper of Kratz, Flower and Coolidge?

A. Yes.

X28. Q. What practical experience have you had in rubber factories?

A. I have never held a position in a rubber factory. I have done consulting work for rubber firms, rubber manufacturing firms.

X29. Q. The actual experience you have had in vulcanizing is then all of scientific or laboratory character?

A. No, not entirely.

X30. Q. To what extent have you had experience in factory rubber vulcanization?

A. In the way of research work, directed to rubber manufacturing problems.

X31. Q. Your work as consulting chemist for one of the rubber companies in the United States and Canada is largely work of that kind, is it not?

A. That is so, yes.

X32. Q. What do you understand by the class of disubstitutedguanidines, which you have referred to in your direct examination?

A. Well, reading it in the light of the patent, I should interpret it as meaning diarylguanidines.

X33. Q. You would say it included all diarylguanidines?

A. I should say so.

X34. Q. Do you know whether all diarylguanidines are rubber accelerators?

A. I do not, no.

X35. Q. How many do you know that are rubber accelerators?

A. I couldn't say offhand, but at least six, I should say, that I know of definitely.

X36. Q. How long have you known about these six?

A. Roughly a year, I should say.

X37. Q. You have known of diphenylguanidines since 1919, and the other five or six for about a year?

A. I should say so, yes.

X38. Q. How many disubstitutedguanidines are there altogether, have you any idea?

A. I don't know how many are capable of staying. Probably a very large number.

X39. Q. Possibly hundreds or thousands or more?

A. No, not as things that any chemist would ever think of preparing, except for some experimental special purpose. The number that would naturally occur to him to prepare, if he were to study that class of substances, is comparatively small.

X40. Q. But my question is not what any chemist would think of preparing, but how many there are that he might prepare, or that might be considered to exist within this class of disubstitutedguanidines?

A. One would have to work that out, I mean on paper. A very large number, no doubt, could exist, just as, for instance, more than three million azo dyes have been calculated as capable of existence, but that doesn't mean as having practical interest. Not more than two or three thousand have ever been looked into—Not that I wish to suggest that anything approaching three million of disubgaunidines are capable of existence. The point is that while theoretically a large number are capable of existence, a comparatively few have any conceivable practical interest.

X41. Q. And you can't say how many of these are accelerators, or would be accelerators?

A. Not absolutely definitely, but in view of the present state of our knowledge, I think I will say that if there were no other group present in the nucleus if a certain group such as nitrates were passing, then all the diarylsubstitutedguanidines would almost certainly be accelerators.

X42. Q. Do you find anything in the patent about the groups you mention as being present and not being present?

A. No.

X43. Q. How would you determine whether any one of this large number of disubstitutedguanidines was a rubber accelerator?

A. By direct experiment.

X44. Q. Making up the compound of rubber and sulphur—

A. That would be a final test.

X45. Q. It is an empirical proposition?

A. No, not wholly; because, as I have already stated, any disubstitutedguanidines, the general type of disubstitutedguanidines, would be an accelerator.

X46. Q. But in order to tell what kind of an accelerator, whether a good one or not so good, what kind of properties it would give, there is only one way of finding it out?

A. When you come down to quantitive differences, undoubtedly a test is the only way.

X47. Q. Let me ask you if this is the abstract which you said you saw in October, 1919? I hand you Chemical and Metallurgical Engineering, for October 1, 1919.

By Mr. Kennedy:

Objected to as incompetent, so far as the date of that publication is concerned, which appears at the top of the page. And upon the further ground, as I understand from my associate, the question of stipulating the date that appears on that publication was considered by him with counsel for the defendant, and resulted in the refusal on his part to stipulate that date, and the reason that he refused, and the reason I refused, to stipulate that date, is because, according to my information, it is quite common for a publication to be issued at a later date than the one it bears, and we know in some of these cases that that is so. Therefore, in confronting

the witness with this paper or magazine dated October 1, 1919, counsel for defendant is confronting him with something the date of which we question, and at the same time misleading the witness, intentionally possibly, into stating at that time he saw this abstract.

By the Court:

If the date were to determine that, it would be a matter of subsequent proof, but as I understand the testimony, it was simply the identification of a particular magazine rather than the fixing of a date. This was merely for the purpose, as I got the inquiry, of the identification of the book. I don't recollect the exact wording of the inquiry put to the witness.

(Question read).

By the Court:

That does bring in an assumption there. As I got it, it was an agreed identification of the paper.

By Mr. Barrows:

If the witness will tell what abstract he saw, from which he got the information, I will be quite satisfied.

By the Court:

There is no question about your dispute as to date. If that becomes relevant in the inquiry, this, of course, is not to be determined in this way. This is not the best proof of that subject, but as a mere identification as to whether

he got it from that particular magazine, or a copy of that magazine, which is identified under that date, and that simply brings into evidence the source of it, and any question is to be subsequently determined and by other proof.

By Mr. Kennedy:

It appears in their question that this is a printed publication more than two years before the filing of our application. They do not have to put this in. If this kind of testimony is to proceed—because they will have enough for argument, at least, and enough to put us on our proof, where we should not be put now, with that abstract which he says he saw in October or September, 1919, was this abstract, and therefore a printed abstract in a printed magazine, and a printed publication within the meaning of the statute of the United States. Therefore, no reference should be permitted to that abstract. As I said before, all they are concerned with is the date. Now, under the guise of seeking further light as to the date, they try to interject this printed publication, to which we object as incompetent.

By the Court:

I know I shall not in passing upon it give it that particular weight which you seem to think. However, there is a good deal in what you say, in so far as a subsequent record is concerned.

By Mr. Barrows:

I am willing to withdraw the question.

RECESS.

AFTERNOON SESSION.

GEORGE STAFFORD WHITBY resumes the stand.

CROSS-EXAMINATION (continued).

By Mr. Wooster:

May I make a request on the record of plaintiff's counsel, before this examination proceeds any further?

By the Court:

You may.

By Mr. Wooster:

I request Mr. Edmonds to confirm on this record a statement previously made to me in New York, to the effect that defendant will not introduce proof of actual publication date of the abstract of the Kratz, Flower and Coolidge paper, published in the issue of the Chemical and Metallurgical Engineering for October 1, 1919. The reason for making this request now is that plaintiff is prepared to prove the actual date of publication of this paper, but on statement made by Mr. Edmonds to me that the defendant would not offer any proof of its actual publication date, plaintiff has not the witnesses here, and desires to either summon them here by telegraph before

the case closes, or to examine those witnesses by deposition in New York.

By Mr. Edmonds:

I don't think that it is incumbent upon me to make a statement of what I propose to do, but I have no objection to reiterating what I said before, that I had no witness to prove the date of a certain publication, and I have not one now. I would like naturally to have proof of that publication, and if any one of plaintiff's witnesses offers to prove the thing I want to prove, I would certainly be very foolish not to avail myself of it. But it is true now, just as I stated in New York, that defendant has no witnesses, and does not expect to have any witnesses, on this particular publication.

By Mr. Barrows:

X48. Q. Can you say now, Dr. Whitby, what abstract it was you saw in October, 1919, of the Kratz-Flower-Coolidge paper?

By Mr. Kennedy:

I assume this is under the same objection.

By the Court:

Yes.

A. Yes. It was a typewritten abstract that Mr. Kratz sent me.

X49. Q. And where did you get that abstract from, do you recall?

A. From Mr. Kratz.

X50. Q. In your direct examination you have

mentioned various advantages which diphenylguanidine presents from a chemical standpoint. It is not soluble in water, is soluble in the rubber, can be kept indefinitely, can be prepared in a fine powder, is a definite chemical substance, does not discolor rubber. Are any of these properties properties which differentiate from triphenylguanidine?

A. Being soluble in the rubber, insoluble in water, stability, and its being a definite chemical compound, and its being preparable in the form of fine powder.

X51. Q. The two things are very similar indeed in these respects?

A. Yes.

X52. Q. And in discussing the advantages of diphenylguanidine from a chemical standpoint, you were not trying to make a point that from a chemical standpoint, diphenylguanidine has any great advantage over triphenylguanidine?

A. I was comparing it with the accelerator of that, but considered it as a whole, and not contrasting it particularly with triphenylguanidine, but with the accelerator's condition taken as a whole.

X53. Q. You do not mean to say that triphenylguanidine was not then known.

A. Certainly not. Reviewing the accelerators then known, some of them, quite a considerable number, could not be said to have all these properties.

X54. Q. In other words, some accelerators not triphenylguanidine, do not have some of the properties that diphenylguanidines have?

A. Yes.

X55. Q. And diphenylguanidine and triphenylguanidine, from a chemical standpoint, have the same or similar properties?

A. Quite similar, as chemicals.

X56. Q. You mentioned, as I recall it, the fact that diphenylguanidine was not soluble in water as an advantage over certain accelerators. Is it very insoluble in water?

A. There is no doubt but it is stated to be very sparingly soluble in water.

X57. Q. Sufficiently soluble, so that you can dissolve it in water, and recrystallize it from water?

A. I don't think so.

X58. Q. You said that diphenylguanidine does not discolor the rubber? That is equally true of triphenylguanidine, isn't it?

A. I should say so.

X59. Q. You said that diphenylguanidine gave a flat-top vulcanized curve. Isn't that equally true of triphenylguanidine?

A. I have not very extensive data on triphenylguanidine, so I would not care to say definitely; but I should say that considering the broad range of other mixtures, diphenylguanidine has undoubtedly an advantage over triphenylguanidine, in respect to the flatness of the vulcanizing curve.

X60. Q. That is your opinion?

A. That is my opinion.

X61. Q. But you haven't investigated triphenylguanidine enough to really know?

A. To say conclusively, no.

X62. Q. In your direct examination, you dis-

cussed the patent in suit, and I call your attention to the example which the patent gives, which is stated to be the preferable method of carrying out the invention? Have you a copy of the patent?

A. Yes, sir.

X63. Q. Beginning at line 98, "The rubber may be compounded in the following proportions: 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, and 1 part by weight of diphenylguanidine." Would this compound be an advantage or give a flat-top curve, which you say is characteristic of diphenylguanidine?

A. To some extent, but I would not say it is absolutely the most suitable compound to bring out the property in the fullest degree.

X64. Q. In fact, this compound is a very quick curing compound?

A. Yes, sir.

X65. Q. And it over cures very quickly?

A. I wouldn't say that that is necessarily so.

X66. Q. Do you know?

A. No, I wouldn't say it over cures very quickly. I will say it will over cure.

X67. Q. Have you ever carried out the example of this patent?

A. Not strictly.

X68. Q. On what basis do you propose to tell the advantages which diphenylguanidines have as an accelerator, if you have not carried out the example of the patent in suit?

A. On other tests.

X69. Q. Tests that are not described in the patent in suit?

A. Tests other than that specific example.

X70. Q. And you don't know whether the process carried out in that example would have the advantages that you describe or not?

A. Yes, I think I may say it would.

X71. Q. But you don't know of your own knowledge?

A. Not by direct experiment with that particular mixture.

X72. Q. You said among the advantages of diphenylguanidine, one was that it permits the use of small amounts of sulphur. Would you call the amount of this example 3.5 by weight to 50 parts of new rubber, a small amount of sulphur?

A. No, I should not say that was a very small amount. It is not as small as is permissible to be given with diphenylguanidine.

X73. Q. In fact, it is much larger than you used as the basis of the tests from which you based your opinion?

A. No; I have used the various proportions for the tests, larger and smaller.

X74. Q. Just what test have you made yourself as the basis on which you make the assertions which you made in your direct examination in comparing diphenylguanidine with triphenylguanidines, and with all other known accelerators, which I assume you have proposed to do in your direct examination?

A. I have not directed any extensive research to diphenylguanidine alone to a greater extent than

the case of other accelerators. I have probably studied about three hundred odd accelerators at one time or another, taken tests with diphenylguanidine, fairly extensive tests, and of course there is a very large amount of material available on diphenylguanidine in literature, which can be subjected to critical examination and passed upon critically, so that one will be in a position from that alone to decide on the advantages of diphenylguanidine.

X75. Q. And part of the information on which your opinions are based is material that is published in the literature?

A. Indubitably.

X76. Q. And you made a thoroughgoing study of the subject and studied various books on diphenylguanidine?

A. In addition to my own work, I studied all of the publications.

X77. Q. Now, in this test which you have made yourself, and which I understand were not the specific example of the patent in suit, what percentage of sulphur did you use with the diphenylguanidine?

A. Used 10 and 5 I think particularly.

X78. Q. Have you any record of these experiments here?

A. Yes, I have one or two.

X79. Q. One or two?

A. Yes.

X80. Q. Have you records here of your comparative tests of diphenylguanidine and triphenylguanidine, or D. P. G. and other accelerators, as the basis on which you made the statement which you did make in your direct examination?

A. I make these statements to a very large extent on what can be ascertained from the literature.

X81. Q. Rather than firsthand information which you have yourself?

A. Well, my first information, my study of D. P. G. is not in itself a very extensive research in itself, to study it in all these aspects to which I referred, and that alone would not enable me to make statements as to its value compared with other accelerators or all those compounds I mentioned.

X82. Q. How much time have you yourself spent in carrying out tests or experiments with D. P. G.?

A. Well, I don't have much time to do laboratory work with my own hands, but I have planned and directed quite a considerable amount of work.

X83. Q. On D. P. G.?

A. Yes, and on D. P. G. accelerators, or accelerators in general.

X84. Q. How much work would you say you have planned and directed, and followed closely, with D. P. G. tests?

A. Well, quite a considerable amount of work. I would not like to say how many tests were involved, but probably something like, perhaps, forty or fifty different rubber mixtures.

X85. Q. You said you had made a thoroughgoing study of the literature as a part of the basis of the opinions that you have expressed. You included, I assume, in that study of the literature, the Kratz paper?

A. Yes.

By Mr. Kennedy:

That is objected to as attempting to introduce into the plaintiff's *prima facie* case matters of defense. Perhaps I am stating this unnecessarily, it being my understanding that there is a running objection.

By Mr. Barrows:

I think when the witness assumes to come here as an expert and base his assertions on statements in literature, that we are entitled to ask him if among this literature there is a particular one.

By the Court:

Yes, we will overrule the objection and note an exception.

By Mr. Barrows:

X86. Q. Dr. Whitby, what is the earliest literature that you have any present recollection of, that relates to the use of D. P. G. as an accelerator?

A. That paper just mentioned.

By Mr. Kennedy:

The same objection.

By the Court:

Objection overruled. Exception noted to the plaintiff.

By Mr. Barrows:

X87. Q. How long have you known the various advantages which you say D. P. G. has over all other accelerators?

A. I haven't stated it has advantages over accelerators in those respects. I was comparing it with the accelerators known in 1919, in general use in 1919.

X88. Q. Limiting my question to the scope of your answer comparing D. P. G. with other accelerators known in 1919, how long have you personally known of advantages which D. P. G. presents over those well-known accelerators?

A. Since about 1923, I should say.

X89. Q. How did you learn what those advantages were in 1923?

A. Well, by a study of results, tests that were made in which I was interested, tests made by friends, and also by study of the literature; a large number of tests carried out in different laboratories.

X90. Q. In fact, that is a customary method of obtaining information about any accelerator, by making a test in the laboratory and studying the literature?

A. Making a test in the laboratory and studying the literature, and observing the way it works out in practice, if it is put in actual commercial use.

X91. Q. How many accelerators would you say there were known in 1919?

A. I wouldn't like to say how many were known exactly, but I could say roughly how many could be introduced for technical use, actual use in the industry, something in the way of, let us say, a dozen that actually came into some degree of use.

X92. Q. Then comparing D. P. G., are you limiting your comparison to this dozen which you say

were then in industrial use, or do you include the larger class of known accelerators, some of which for one reason or another may not have come into use?

A. No, I don't refer to the large class.

X93. Q. But you know that there was a very large number of known accelerators in addition to those which have come into industrial use?

A. Yes, the presumption, of course, is that they hadn't any advantages, and those that were tried industrially were those which appeared to be the most advantageous ones.

X94. Q. But one of the considerations would, of course, be the price of the accelerator in commercial use?

A. Of course.

X95. Q. And if it was only available at a prohibitive expense, it wasn't industrially used, no matter how good an accelerator it would be?

A. Yes.

X96. Q. You spoke about the ageing qualities which D. P. G. has. Are you also familiar with the fact that T. P. G. also gives good ageing qualities to rubber, or is that something you are not sufficiently familiar with?

A. I have not an extensive data available on T. P. G., but comparing the capacities of the two accelerators tested, in a general way, I should undoubtedly say that D. P. G. is capable of giving qualities that will improve upon T. P. G.

X97. Q. Just what comparison do you refer to in determining that?

A. I have in my original testimony tried to develop the fact that D. P. G. was such a powerful accelerator that it was possible to cure rubber with a small amount of sulphur and leave very little free sulphur in the mixture. It is no doubt possible to do that with D. P. G. which is not possible with T. P. G., and therefore the general principles, considering the results of rubber as such, in general, would cause you to use the advantages that D. P. G. gives, because you could cure with less sulphur than in the case of T. P. G., and will in general give better ageing qualities.

X98. Q. That wouldn't be from compounds containing a large amount of sulphur and large amount of T. P. G.?

A. Not necessarily in working from that general principle.

X99. Q. In fact, this patent in suit with two per cent of D. P. G. on the rubber, and 7 per cent of sulphur on the rubber would be a very good ageing compound, unless you were very careful about curing it?

A. Well, if it were cured properly, it would, but it is not the ideal preparation.

X100. Q. It wasn't a test on a compound like that on which you based your differentiation against T. P. G. and D. P. G.?

A. No, not on a compound like that.

X101. Q. You spoke of one advantage of D. P. G. as being that it is inactive in calender and mill; T. P. G. has that same advantage, hasn't it?

A. I don't know that I have any data on that,

but I should say that it is comparatively satisfactory.

X102. Q. What practical experience have you had with T. P. G.?

A. What do you mean by "practical?"

X103. Q. Commercial experience, actual commercial use?

A. I have had no use in rubber factory.

X104. Q. You are not familiar with the methods of using T. P. G. in commercial rubber factories?

A. Well, I think I am familiar with them, but not by actual practice.

X105. Not by firsthand information, how it is used and what results are obtained?

A. Not by actual practice; no, sir.

X106. Q. Have you ever compared D. P. G. with T. P. G. in an example such as the patent in suit mentions, and used a larger amount of T. P. G. than of D. P. G.?

A. No.

X107. Q. Do you know whether a larger amount of T. P. G. would speed up the vulcanization and give the other desirable qualities which you say D. P. G. gives?

A. No, I say it is not possible to have quite as good a product from T. P. G. as from D. P. G.

X108. Q. That is your opinion?

A. Absolutely.

X109. Q. In your direct examination, you were asked whether a certain practice which is used by this defendant was within the claims of the patent in suit, or was an embodiment of the invention of

the patent in suit; would you say that any vulcanization of rubber with sulphur and with D. P. G. was the practice of the invention of this patent in suit?

A. I should say so, so long as it produced acceleration, as soon as you had sufficient to produce acceleration and improve the properties of the product.

X110. Q. And that would be true whether a mixture of rubber and sulphur and D. P. G. had various compounding ingredients with it or if there were other compounding ingredients?

A. Yes.

X111. Q. You stated that rubber and sulphur are seldom used alone. It is true, of course, isn't it, that in commercial compounds many different compound ingredients are used?

A. That is true.

X112. Q. Oxide and fillers and different ingredients of one kind or another are common practice?

A. Yes.

X113. Q. Have you any idea how many standard commercial compounds one of the large rubber companies in this country would have, say, for automobile tires?

A. Well, yes.

X114. Q. How many would you say?

A. Confined to automobile tires only?

X115. Q. Yes?

A. Well, with regard to one particular article, I would not like to say.

X116. Q. Fifty or one hundred?

A. That had been worked out, you mean?

X117. Q. No, in one factory in making a line of ordinary tires?

A. I should not say as much as fifty.

X118. Q. But a number?

A. Yes, considerable.

X119. Q. You haven't had any practice to say how many compounds one of the larger rubber companies would have for its line of tires?

A. No, I wouldn't like to say.

X120. Q. Are you prepared to say how many compounds one of the larger rubber companies would have in making rubber goods, not only tires but various other articles? Do you think it might have one thousand or more?

A. Yes, they might have a thousand.

X121. Q. Now, as a consulting chemist of one of those large rubber companies, how would you go about working to adapt D. P. G. to any one of those hundred or thousand different compounds in the rubber company? Just what would you do as a practical consulting engineer?

A. I should study it under very simple conditions, to begin with.

X122. Q. Take a sample compound and test it and see what it would do?

A. Yes.

X123. Q. And then you would take the compounds and you would make up your standard test formula, and with varying amounts of sulphur and accelerator, and finally you would come to the com-

pound and cure that would be the best for that particular purpose?

A. Yes.

X124. Q. That is the common practice in rubber laboratories?

A. Yes.

X125. Q. And has been for many years?

A. Yes.

X126. Q. Both before the days of organic accelerator and ever since?

A. Yes.

X127. Q. And that is what the chemists and assistant chemists are doing as part of their daily routine in rubber factories?

A. Exactly.

X128. Q. In fact, every rubber company of any importance has a laboratory with rubber chemists carrying out this kind of test every day, don't they?

A. Yes.

X129. Q. And it is from the result of these laboratory tests that they develop the factory compounds to control the factory practice?

A. Yes.

X130. Q. I think you stated that accelerators had been used from the earliest days, even at the beginning?

A. Yes.

X131. Q. That is my recollection; is that correct?

A. Yes.

X132. Q. Even Goodyear in his early work used lead oxide and litharge?

A. Probably not with definite recognition of its function.

X133. Q. And since that time you have learned a great deal about lead oxide and litharge, and Goodyear found he was doing something?

A. Yes.

X134. Q. I think you mentioned other inorganic accelerators, and I think you mentioned lime and magnesium oxide?

A. Yes.

X135. Q. And these are used in rather small amounts and will give quite a decided acceleration?

A. Yes.

X136. Q. And may I also say that the rubber vulcanized with these accelerators is a better product, and has better properties, than rubber vulcanized without them?

A. I might say so, yes. The advantageous properties would differ in different cases as to what you wanted it to apply.

X137. Q. And one advantage that results from using accelerators, even inorganic accelerators, is that you get a better product?

A. I think I might say that, yes.

X138. Q. And isn't it also true that since organic accelerators have been used—commercially true—the last dozen years, that it is often possible to get better products with their use than with the old inorganic accelerators?

A. One cannot use the term "better" without some reference to the use to which the rubber is to be put, but for many purposes better.

X139. Q. Take the large tonnage of rubber used in automobile tires. The use of accelerators during the last dozen years has improved very greatly the properties of rubber tires made with organic accelerators; you are familiar with that?

A. Yes.

X140. Q. And it has been the practice for several years, even back of 1919, to use organic accelerators that give these greatly improved properties in rubber tires?

A. Well, it is a question of distinction, because all accelerators do not give an improvement to the same extent, or not in as many respects, or they may have an advantage in one respect but be put to some disadvantages in another respect. So you cannot make such broad sweeping statements.

X141. Q. My statement is not broad or sweeping; it is a very specific one, that so far back as 1919, or earlier, the tires made commercially with organic accelerators had vastly superior properties over those made before the days of the orgonic accelerators?

A. I would say they have superior qualities.

X142. Q. And with different accelerators you would get different properties peculiar to accelerators you used, or you might get them?

A. You might get them.

X143. Q. And the result would also depend on such things as the amount of sulphur, or the presence or absence of other factors?

A. Those are the factors.

X144. Q. In fact, some of these other ingred-

ients may influence greatly the accelerating power of the accelerator, may they not?

A. Yes.

X145. Q. So that in any particular combination, no matter what your knowledge may be of an accelerator, you have to consider what influence the other ingredients have on the accelerator you are using?

A. You do.

X146. Q. And the only way that you can satisfy yourself would be to try it out and get first-hand information on that particular combination?

A. Yes, ultimately; that is the satisfactory method.

X147. Q. Are you familiar with the amounts of D. P. G. that are used commercially, the percentages of D. P. G., on rubber?

A. Yes.

X148. Q. What does that percentage amount to?

A. Well, I should say that probably the most frequent percentage is something in the way of one-half per cent, or possibly two-thirds, up to one.

X149. Q. Are you familiar with commercial uses as low as one-tenth of a per cent, or twelve one-hundredths of a per cent?

A. No.

X150. Q. You are not familiar with any such commercial use?

A. No.

X151. Q. In your study of the literature, do you know whether the Dovan Company has published papers recommending as low as twelve one-hundredths per cent?

A. No.

X152. Q. In your study of the literature on which you have based your opinions, do you recall this article appearing in the India Rubber issue of June, 1924, entitled "Diphenylguanidine?"

A. I believe I saw a similar article in French.

X153. Q. And this has a footnote that the data was supplied by the Dovan Chemical Corporation?

A. So I see here. I don't believe I noticed that in the French article.

X154. Q. In the second column of this page 589, under "Typical Compounds for Inner Tubes," the second compound is headed "Heavy Blooming Tube Rubber 100, Sulphur 5, Zinc Oxide 5, D. P. G. 125." You don't recall that particular compound as one of the commercial compounds?

A. No, I have no information.

X155. Q. Do you think that might be a commercial compound?

A. Well, not one that I personally should advise.

X156. Q. You said of D. P. G. that one of its advantages was that it produced non-blooming products. This particular compound we are discussing would be a heavy blooming compound. Do you agree with that?

A. Yes.

X157. Q. The bloom is due largely to the amount of sulphur present?

A. Yes, one of the factors.

X158. Q. In other words, you can make either bloom or non-bloom stock with D. P. G., whichever you please?

A. Yes.

X159. Q. In your direct testimony you refer to the patent, using the word "texture." You assume to state what you understood by "texture." Is that a recognized term of rubber technology.

A. It is not a commonly used one. We have terms such as toughness, tearability and perhaps grade, which is perhaps involved in tearability, and perhaps are all indicated generally by this term "texture."

X160. Q. But that term is not one of the common terms of the rubber chemists used in describing products made by vulcanizing rubber?

A. It is not used commonly, no.

X161. Q. So that your interpretation is something that you think was meant by it, and not something you can go to a dictionary and find, such as "tensile strength."

A. Yes.

X162. Q. Will you refer to the top of the second column of page 1 of the patent in suit, where it refers to the vulcanizing of hard rubber articles? It states "The use of diphenylguanidine not only hastens the vulcanizing action, but results in a final product much superior in texture, strength, duration and aging qualities over that when triphenylguanidine is used." Have you ever produced hard rubber with D. P. G. and T. P. G., to see whether that statement is in accordance with the fact?

A. No, I never did any experimental work.

X163. Q. And a little below that, on the same page, it says, "In these and similar instances, it has

been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressures than those commonly employed." Do you know whether that statement is true or not?

A. Yes, I should say it is.

X164. Q. But that would depend a great deal upon how much D. P. G. and how much T. P. G. you use?

A. You mean the ratio or absolute amount?

X165. Q. The absolute amount or ratio. A higher amount of T. P. G. as compared with the lower amount of D. P. G. might not give any such results as that?

A. Well, defining the period of vulcanizing as the period required to get the especial qualities with that given accelerators, undoubtedly it would increase the amount of T. P. G. as compared with D. P. G., if you are going to make more equal the times required for vulcanization.

X166. Q. Then you would say this statement applies only when the amounts used are the same?

A. I should say that is the opinion of the statement, yes, although as a matter of fact, I believe no matter how much T. P. G. you took you could not get a rubber combination to cure as good as you could by the use of D. P. G.

X167. Q. That is your opinion?

A. That is my opinion.

X168. Q. Referring again to the advantage which you mention of D. P. G., that it permitted obtaining

a product with no free sulphur left, would you say it is possible to obtain such product with the combination of the specific example of the patent in suit?

A. Of course it is possible to obtain it with no free sulphur, yes; with substantially no free sulphur.

X169. Q. That is, with seven per cent of sulphur on the rubber?

A. If you care to vulcanize it on that basis.

X170. Q. Would the product be any good?

A. Not as good as if you didn't vulcanize so long.

X171. Q. Overcured?

A. Overcured.

X172. Q. And probably a worthless product for commercial purposes?

A. Yes.

X173. Q. And in that case you wouldn't say that the freedom from sulphur was an advantage?

A. Not when overcured.

X174. Q. Do you find anything in the patent which indicates that with a smaller amount of sulphur it is possible to get no free sulphur compounding without overcure?

A. Well, it is implied, I think.

X175. Q. Where does it tell you what to do to do that?

A. It doesn't tell you the specific conditions to achieve that end.

X176. Q. But those conditions would be different from this specific example?

A. Yes.

X177. Q. You will admit, Dr. Whitby, that there is a great deal more known about D. P. G. now than there was say four or five years ago?

A. Yes.

X178. Q. And that same thing is true about other accelerators—many other accelerators?

A. Yes, many others.

X179. Q. And we are learning new things about them right along?

A. Yes.

X180. Q. And it is still rather an obscure question as to just how accelerators work?

A. Yes.

X181. Q. The vulcanization of rubber, which you discussed in your direct examination, that is a progressive process, isn't it?

A. Yes.

X182. Q. The process is one that gradually comes to completion over whatever time it takes to bring it to completion?

A. Yes.

X183. Q. One of the facts that has been known for many years in the art of accelerators is that in general the strong nitrogeneous base is a good accelerator. That is a fact, isn't it?

A. As a general rule.

X184. Q. And that fact has been known for the past dozen years or so?

A. Yes.

X185. Q. As far back as 1912 or a little later, as you pointed out at page 196 of your book, the

claim was made that by nitrogeneous organic bases, which possesses a dissassociation constantly greater that 1 x 10^{-8} are accelerators. You thought this statement of claim was of sufficient importance to warrant placing it in your book, didn't you?

A. Yes; merely accepting it without prejudice, we will say.

X186. Q. And if that generalization were one that could be accepted, and you knew that D. P. G. was a strong base, would you understand from that it was also an accelerator without trying it?

A. If that statement were true, universally true, undoubtedly.

X187. Q. But you might question the statement?

A. Yes, certainly.

X188. Q. How would you determine whether any particular compound that was known in the realm of organic chemistry would vulcanize rubber or not?

A. Well, as a general rule, I should probably incorporate it into a mixture of rubber and sulphur, possibly with zinc oxide, and vulcanize that, in comparison with a similar mixture from which the accelerator was absent, or in which the accelerator which was satisfactory was present, vulcanize them and subject them to other tests.

X189. Q. By comparing the two tests, one without the substance, and one with the substance, you could tell from the results whether it was an accelerator or not?

A. Yes, I would say so.

X190. Q. And would you say there was no other way known to other chemists, except to try it?

A. Well, there are other methods of testing it.

X191. Q. But to tell whether any particular substance is a rubber accelerator?

A. There are other methods of testing it, but none as unexceptional as that was.

MORRIS L. WEISS, a witness called on behalf of the plaintiff, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation?

A. Morris L. Weiss; Newark, New Jersey; age thirty-eight; chemist.

2. Q. With what company are you connected?

A. With the Dovan Chemical Corporation, chief chemist in D. P. G. research.

3. Q. Are you also an officer of that corporation?

A. I am second vice president.

4. Q. Are you a stockholder in the corporation?

A. Yes.

5. Q. To about what proportion.

A. Twenty per cent.

6. Q. Where were you born?

A. Russia.

7. Q. When did you come to the United States?

A. In 1904.

8. Q. Had you had any schooling before you came to the United States?

A. Public schooling.

9. Q. What schooling did you have after you came to the United States?

A. Evening schooling and high school subjects.

10. Q. Where?

A. The Temple College, Philadelphia.

11. Q. During what period did you reside in Philadelphia?

A. From 1904 to 1908.

12. Q. Where did you go then?

A. To New York.

13. Q. How long did you reside in New York?

A. From 1908 to 1917.

14. Q. Where did you then go?

A. To Youngstown, Ohio.

15. Q. What did you do while you lived in New York?

A. Why, I attended the school of Applied Science, Cooper Union Institute, New York City, from 1908 to 1913. I graduated as chemist.

16. Q. Did you have any further education at any school in chemistry after you graduated from Cooper Union?

A. Yes; I entered the Polytechnic of Brooklyn, and graduated in 1916 with the degree of Bachelor of Science in Chemistry, my major being Organic Chemistry.

17. Q. During this period were you employed?

A. Yes; I was research assistant at Harriman

Research Laboratory, Roosevelt Hospital, New York City.

18. Q. During what period?

A. 1913 to 1916.

19. Q. With whom were you most closely associated?

A. Dr. I. Greenwald. I also was associated with Dr. Greenwald from 1912 to 1913, prior to my going to the Harriman Laboratory, he then being connected with another research laboratory.

20. Q. What kind of research was this?

A. Why, chemical research.

21. Q. What class of chemistry?

A. Chemistry pertaining to life.

22. Q. You mean bacteriological?

A. No, not necessarily. That is animal life—Bio-chemist.

23. Q. Up to this time had you had any experience with rubber chemistry?

A. No.

24. Q. Are you the Morris L. Weiss, the inventor of the patent in suit?

A. Yes.

25. Q. When you moved to Youngstown, Ohio, what did you do?

A. Obtained employment at the Republic Rubber Company.

26. Q. In what position?

A. General analytical chemist.

27. Q. What were your duties as analytical chemist?

A. Analyzing all various raw materials used in the manufacture of rubber goods.

28. Q. Will you name some of those raw materials which you analyzed?

A. Iron oxide; aluminum flake; clays; zinc oxide; letharge; magnesium; also cured rubber; finished rubber articles; fine air (?) ingredients. There is other materials like oils, waxes, gums.

29. Q. During what period did you do this work?

A. Why, the first few months I was employed there.

30. Q. Under whose direction did you do this work?

A. Mr. Clinton A. Carlton.

31.Q. What was your next position?

A. I was after that assistant chemist in the preparation of some organic compounds to be applied on accelerator vulcanization.

32. Q. Was this the first time you had experience with compounds for the acceleration of rubber curing?

A. Yes, sir.

33. Q. Under whose direction did you work at this time?

A. Under Mr. Clinton A. Carlton.

34. Q. For how long a time did you continue on this work?

A. Up until the time he left the employ of the Republic.

35. Q. When did you conceive of the use of D. P. G. or disubstitutedguanidines as an accelerator for the vulcanization of rubber?

A. I would say on or about March of 1918.

36. Q. Did you disclose that conception to anyone at the time?

A. I did.

37. Q. To whom?

A. To Clinton A. Carlton.

38. Q. Was this disclosure made to Mr. Carlton before or after he left the employ of the Republic Rubber Company?

A. Before.

39. Q. How long before?

A. Shortly before.

40. Q. Do you remember when he left?

A. In March of 1918.

By Mr. Wooster:

I would like to call Mr. Carlton now as a courtesy, to enable him to get back to his office tomorrow.

By the Court:

All right; we will allow you to do so.

(Witness withdrawn for the present).

CLINTON A. CARLTON, a witness called on behalf of plaintiff, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. Please state your name, age, residence and occupation.

A. Clinton A. Carlton; twenty-nine; Mansfield, Ohio; chief chemist of the Columbia Tire & Rubber Company.

2. Q. How long have you been connected with that company?

A. Approximately three and a half years.

3. Q. With whom were you employed previously?

A. Previously with Kelly Springfield Tire Company.

4. Q. Where were you educated?

A. University of Akron.

5. Q. After you left the university, where were you employed?

A. Republic Rubber Company.

6. Q. Between what dates were you employed at the Republic Rubber Company?

A. I went with the Republic just after graduation, which I think was the first week of June, 1917, until approximately the latter part of March, 1918. I don't remember whether it was the latter part of March or first of April; it has slipped my mind.

7. Q. After you left the Republic, what did you do?

A. Returned to the University of Akron.

8. Q. While with the Republic, what was your position?

A. Well, when I first went to the Republic I went there as organic chemist, but shortly after I took up my duties there, I was given charge of the chemical department upstairs. The laboratory was divided into two distinct divisions, one the physical or routine division and the other mechanical work, which includes control work, and what research we could do at the time.

9. Q. Just previous to your leaving the Republic, what was your position?

A. Well, I had complete charge of all the chemical work, strictly chemical work.

10. Q. What did that include?

A. It included usually control analysis of all incoming materials, checking the compounds that were cured in the laboratory, for instance, testing rubber shipments and in addition to that, of course, directing the work along the lines of accelerators and organic preparation work. We also did considerable experimental work, compound testing out of different new materials.

11. Q. Did you have any assistance in the work on accelerators?

A. Yes. Weiss worked for me. I cannot remember exactly when he came with the Republic—the latter part of 1917. He worked on analytical work for a very short time. Then he was turned over,

that is, I put him on organic work, assisting me in the work of organic preparations.

12. Q. You mean Morris L. Weiss, who is here present?

A. Yes, sir.

13. Q. And who preceded you on the stand?

A. Yes, sir.

14. Q. Did Mr. Weiss ever disclose any conception of his as to rubber accelerators?

A. Of course, at the time Weiss came to the Republic, he knew practically nothing about rubber, but after we started work on the organic accelerators, of course it was one of my duties to teach him as much as possible about organic compounds and their use in rubber as accelerators, and after he had gotten started in the work and began to learn what an accelerator was, naturally he had ideas as to what might be possible to try, as we were continually searching what little literature we had at the time—laboratory facilities at the Republic were extremely limited, and a great many of the things we were trying were things I had jotted down before I came with the Republic, from time to time, not meant as accelerators but simply organic compounds that might have possibilities.

15. Q. Did Mr. Weiss mention any to you?

A. He did.

16. Q. Do you recall the names of any?

A. I remember distinctly one thing that he called to my attention. We had an old Richter organic chemistry book. At that time we were working in a general way on guanidines, and of course at

that time I knew of T. P. G. as an accelerator. I had tested that before I came with the Republic. I wasn't particularly interested in it at that time. I was more interested in the time in possible guanidine derivatives that might be had from dicyandiamid, because that was a product that could be obtained and offered possibilities of obtaining a good derivative or organic compounds. But in this Richter there was mention made of a very few of the guanidines, D. P. G. being one of these. And as I remember it, this occurred just shortly before I left, I imagine a week or so. I left rather suddenly on account of the war. I went back to the University and went into the service at the University, in the War School there. He mentioned that these various substances might be tried, naturally from the fact that T. P. G. was already known as an accelerator, and I remember that in our last discussion which we had before I left—I don't remember whether Mr. Daniels was present or not—that the guanidine class of the thiourea. would probably be as good a field to work in as any, that is, to continue his work.

CROSS-EXAMINATION.

By Mr. Edmonds:

X17. Q. Do you recall when it was that you got this idea that the guanidines would be a fruitful field to work in?

A. Only from the fact that T. P. G. was known; that is all. At that time I think T. P. G. was the only substance that I knew anything about that had been tried, and I tried that and worked on that

at the Miller Company before I went with the Republic.

X18. Q. And back there in the days when you were with the Miller Company, you thought this whole field of guanidines would be a fruitful field to search through, particularly as you knew T. P. G. was a good accelerator.

A. Well, to make a specific statement to that effect, only in so far that you had a substance in one particular class that had proven to be an accelerator, it would be well to work on other derivatives.

X19. Q. It would be worth while to try others to see if they were better?

A. Why, certainly; always looking for something better than we had before.

X20. Q. Did you do anything in the way of trying either of them?

A. I did not myself. I remember we had dicyandiamid to work, on what derivatives we had to work from, that being raw material, but so far as having prepared any other guanidines, when I was with the Republic we did nothing. The main part of our work at that time was trying to put into the production one of the newer compounds known at the time.

X21. Q. Did you talk with any other members as to trying the use of this?

A. Do you mean Mr. Daniels?

X22. Q. Yes.

A. I suppose we did. Mr. Daniels and I used to have conferences in his office once a week.

X23. Q. And it was your idea to try other members of the guanidines?

A. Naturally we had little time to spend on that one particular subject, but that was my prime object, outside of routine work, to spend all of my time on organic accelerator compounds.

X24. Q. And the only way you could find out was to put some in a rubber compound and make a test and examine them?

A. Yes.

X25. Q. But before you got around to performing these tests yourself, you left the Republic?

A. Well, I did try other compounds not in the guanidine list, a few phenyl thioureas.

X26. Q. You had in mind that you would try other members of the guanidine group, but before you got around to it you left the Republic Company?

A. Yes.

X27. Q. But shortly before you left the company, one time when you and Weiss were discussing accelerators, and you had Richter in front of you, or one of you opened Richter to the page where T. P. G. appeared, and in the course of that discussion Weiss stated that it might be worth while to try D. P. G. to see if that would be an accelerator?

A. The exact case as to how it came about, Weiss had evidently been going through Richter, either at the plant or at home, and had noticed this, and had brought the book to me, but whether or not that is on the same page as T. P. G. I couldn't state; I haven't any idea.

X28. Q. And he said to you that maybe this D. P. G. will be a better accelerator, and you said "Maybe it will; we had better try it?"

A. Yes.

X29. Q. That is the substance of it?

A. Yes, that is true.

X30. Q. Have you read any part of your testimony that you gave in the National case?

A. No, I haven't.

X31. Q. Before going with the Republic you were with the Miller Rubber Company?

A. Well, I might explain that so there won't be any mistake. I worked for the Miller Rubber Company in my vacation in my junior year, and afternoons and Saturdays during my senior year; so that I worked with the Miller Company and went to school at the same time. But upon graduation I went directly to the Republic.

X32. Q. That was in June, 1917?

A. Yes.

X33. Q. In the National case, in one part of your testimony, you said, "It is well known that the length of time a compound is cured, other things remaining equal, the longer the stock is cured, the lower are its physical properties at optimum." You don't wish to make any change in that statement?

A. No, I believe that is true.

X34. Q. When did you learn that?

A. Well, from the very beginning. One of the things that we had to do at college—I took a course in rubber chemistry while at the University, and those various things were brought out. At the time I made that statement, it was generally recognized that heat effect upon rubber is deleterious, and that

is just a general statement that the longer stock is cured the lower will be its physical properties.

X35. Q. And that is a fact that all of the members of your class learned in college?

A. In addition to the practical experimenting.

X36. Q. I say, that statement of fact there about the curing of rubber is a statement that you and your classmates learned in college back there in 1917?

A. Yes.

X37. Q. It was true then, and has been true ever since, and has been known to all rubber chemists?

A. Yes, in a general way. Perhaps you would only differentiate in time by a few minutes, one substance might show different, but over long periods of time, so if you would change a compound from a four-hour cure to a two-hour cure, that the two-hour cure would be the optimum.

X38. Q. You recited the same thing here, that heat itself has a deleterious effect upon rubber?

A. Yes, sir.

X39. Q. That is true, as a general statement, about vulcanization?

A. I think so.

X40. Q. And that you learned in college, and your classmates learned it with you?

A. I won't say I learned all these things in college. I might have learned these things after I left college. These things are common knowledge.

X41. Q. And it was common knowledge back there in 1917?

A. There wasn't as much proof behind it at

that time as there is now, but it was recognized as a fact.

X42. Q. Now, an accelerator, of course, hastens the operation of vulcanizing, and therefore as a result of having an accelerator in the mix, the vulcanization may take a less length of time?

A. True.

X43. Q. And because it takes a less length of time, that is, because the compound is subjected to heat for a less length of time, the physical properties are better?

A. That is one of the factors which increases the physical properties.

X44. Q. Carrying the matter a little further, you said in your testimony in the other case, "You can make better stock with D. P. G., I believe, than it is possible to make with T. P. G., just simply for the reason that the stock or compound does not have to be heated for such a length of time?"

A. In general, that is true.

X45. Q. You have no reason for wanting to alter that? That is just the same as you understood it then?

A. Absolutely.

REDIRECT EXAMINATION.

By Mr. Wooster:

46. Q. In that same answer from which the last answer was quoted, did you not also say, "Tensile is higher, which is the main thing" (reading from page 380 of the National record, and just immediately

opposite the answer quoted in the last cross-examination)?

A. Yes, that statement was made there. Tensile is higher, which is the main thing. I don't know that statement could be changed a little. Nowadays there is a great deal more known about their physical properties. Tensile is extremely important in some particular compounds, but at the same time there are other properties which are even more important than tensile for specific uses, but tensile is one of the indications of the high quality of the compound.

47. Q. At the time you left the Republic, do you recall the names of any of the substances which were on the list to be tested for accelerating possibilities?

A. I don't know as we made out an actual list; I couldn't say as to that or not, but I do remember that during the last week I was at the Republic, as I have stated before, that the guanidine class or the thiourea was a good field to work in. I had very little time to discuss the matter with Weiss, as to what he should proceed to do, or even with Mr. Daniels, as I was, I think, to leave within two or three days of the time I actually left.

48. Q. Do you recall the names of any other specific materials other than you have given?

A. You mean, that we had already tested out or had in mind?

49. Q. That you had already either fully tested and rejected or accepted, or had partly tested, and had arrived at no conclusion on, or those that were still to be tested?

A. Well, since that time I have done so much on accelerators, tested so many, that it would be rather difficult to state. I remember that we tested out phenyl thiourea. That was one of the things that showed promise, the objection to that being its expense. It was small in comparison to hexa. Among other things, I remember I had in mind to try ethylenediamin. As I stated previous to this time I was more interested personally in aliphatic compounds than I was in aromatic. I have learned since that I was mistaken, but I had always been interested in the derivatives of compounds that could possibly be prepared from dicyandiamid. Dicyandiamid was a chemical product at the time, and there was a great many compounds that could be prepared from it, many of which have been prepared since that time.

By Mr. Edmonds:

50. Q. Would a compound of 50 parts of rubber, 45.5 of zinc oxide, 3.5 sulphur, 1 part D. P. G., have what you would consider a flat curing curve?

By Mr. Wooster:

I think that is outside the direct testimony.

By the Court:

I do not think we will go into that, because this witness was not called as an expert.

By Mr. Edmonds:

If I can show that this witness contradicts another witness, I think I should be permitted to do it.

By the Court:

No, you can contradict that witness by your own witness.

MORRIS L. WEISS, recalled, testified as follows:

DIRECT EXAMINATION (Continued)

By Mr. Wooster:

41. Q. Do you recall any specific substances which were to be tested at the time Mr. Carlton left?

A. Well, I prepared the phenyl thiourea for him. He ordered some dicyandiamid, and there was T. P. G. to be tested, and I had in mind a few others I was going to prepare.

42. Q. I am asking you to give the names of all the substances you prepared, which were either on the written or oral program to be tested at the time Mr. Carlton left the Republic. Can you recall any substances?

A. There was no list made out then to be tried, and I mentioned some of them; the D. P. G. was to be tried when I had it made.

43. Q. Do you remember any others that were to be tried either when made or bought in the market, or taken out of stock already in the place?

A. Yes, there were a few there, like paraphenylenediamine and faranitrosodimethyl analin, and there was formaldehyde analin.

44. Q. Any others?

A. Yes, paratoluolsulphamid and paradiaminodiphenylmethane.

45. Q. Which of the substances you have mentioned were subsequently prepared and tested, to your knowledge?

A. Formaldehyde analin; T. P. G.; parotuluol-

sulphamid and paradiaminodiphenylmethane; I also tested dicyandiamid, which I got in; and paranitrosodimethyl analin.

46. Q. What next did you have to do with D. P. G. after Mr. Carlton left?

A. Well, the description was rather meagre in the way of giving a method of preparation, and I had no idea how to prepare it, so I went down to the library in Youngstown there, and searched for the method of preparing D. P. G. There is a public library there. And in May of 1918 I went down there and found several volumes of reference works by Roscoe and Schorlemmer, and in one of the volumes I found a description of the physical and chemical characteristics of D. P. G., also a brief description of some of the methods of preparing the same, and also references to the original literature of which this was abstracted. I copied that information on a piece of notepaper.

47. Q. What next did you do?

A. Well, I did not start on the preparation of P. D. G. immediately, for the reason that I was planning to spend my vacation in New York City the following month, and I decided while in New York City to get some more information, or all the possible information I could get, on methods of preparing D. P. G., in the New York Public Library, as the information contained in the Youngstown Library was rather of an abstract nature.

48. Q. Did you go to New York, and when?

A. Yes, I went to New York in June of 1918.

49. Q. Did you find any additional information on the method of preparing D. P. G.?

A. I did find a more detailed description of one method of preparing D. P. G.

50. Q. What did you then do?

A. Why, I returned to Youngstown.

51. Q. Then what did you do?

A. Why, I immediately upon my return—I was busy in purifying paraphenylenediamine, in which Mr. Munroe H. Daniels, chief chemist, was interested. I devised a small laboratory in order to purify the product that way, which I did.

52 Q. After Mr. Carlton left, under whose direction were you?

A. Under Mr. Munroe H. Daniels, chief chemist.

53. Q. What else were you doing during the summer of 1918?

A. Well, I was given charge of the analytical laboratory when Mr. Carlton left, and all the work done there of an analytical nature was under my direction, and any spare time I devoted to preparing and testing out certain organic compounds and accelerator vulcanization, outside of other problems of a research nature, like the purification of paraphenylenediamine.

54. Q. Did you make any D. P. G.?

A. Yes.

55. Q. When?

A. I started the preparation of D. P. G. in September, 1918.

56. Q. About how much did you make?

A. Why, by the time I got through with the

first two experiments, one of them being discarded, I got about five grams of D. P. G.

57. Q. What did you do with that?

A. I compounded it in a rubber compound, to try out its activity to find out what it would do with the rubber.

58. Q. When was that done?

A. In December of 1918.

By Mr. Edmonds:

59. Q. The compounding was done in December, 1918?

A. That is right.

60. Q. When did you get the five grams?

A. By the end of November, I judge the compounding was really started the first week in December, as I remember.

By Mr. Wooster:

61. Q. Was there any record made of the manufacturing of the D. P. G., and of the first compounding of it with rubber?

A. A record was made for the actual preparation of D. P. G., the compounding of D. P. G. No written record was made at this time of the results obtained in compounding D. P. G. with rubber.

62. Q. What were the results of the first tests of D. P. G. compounded with rubber?

A. Why, the first slab of rubber compounded by the use of D. P. G. was overcured.

63. Q. When was this?

A. This was in December of 1918.

64. Q. What was the formula?

A. The formula was the regular standard rubber accelerator test recipe, which consisted of 50 parts of pure rubber, 4 parts of sulphur, 2 parts of magnesium, 1 part accelerator, 43 parts zinc oxide.

65. Q. What was the cure?

A. The cure was 50 minutes at 40 pounds, was the first cure I gave it.

66. Q. Did you do this work entirely yourself, or did you have assistance?

A. Why, I weighed out the rubber, the sulphur, the accelerator, but the actual cure was done in the experimental mill room, and the mixing in the cure.

67. Q. In your presence?

A. The mixing was done in my presence.

68. Q. How about the curing?

A. The start of the curing was done in my presence, as the rubber was put in the press and the steam turned on, and then I went back to the laboratory, and I was generally called back when it was time to take the rubber out of the press.

69. Q. Who did the curing?

A. Mr. William Holliday.

70. Q. After obtaining this first overcure with D. P. G., what did you next do with it?

A. I told him to cure another slab of rubber with the same compound, for 40 minutes, at 40 pounds, and see what he would get then?

71. Q. Was that done?

A. Yes.

72. Q. What was the result?

A. It was overcured.

By Mr. Edmonds:

73. Q. When was that second one?

A. That was in December of 1918.

By Mr. Wooster:

74. Q. What formula?

A. Why, the same formula and the same rubber stock as I used for the first cure.

75. Q. How did you tell that these stocks were overcured?

A. By cutting a strip off the finished cured rubber slab and pulling it. The strip of rubber broke immediately, showing it was overcured. Also, by the feel or snap of it, and from the way it came back.

76. Q. Was the second cure as much overcured as the first?

A. Why, it was pretty well overcured. It was hard to tell to what degree the overcure was.

77. Q. What did you do then with D. P. G.?

A. I then asked Mr. Holliday to cure another slab of the same compound for thirty minutes at forty pounds.

78. Q. Did he do it?

A. Yes.

79. Q. When?

A. Soon after the second cure was obtained, in December of 1918.

80. Q. What was the formula of this cure?

A. It was a slab of the same stock originally prepared, and from which all of these cures were made.

81. Q. What was the result of this third cure?

A. It was also overcured.

82. Q. How much, in comparison with the two previous ones?

A. Why, it was difficult to tell to what degree the overcure was, even at that stage, but it showed a definite overcure.

83. Q. Up to this time did you consider these results encouraging or discouraging?

A. I considered them indicative and encouraging; indicative of the fact that D. P. G. was a powerful accelerator, and encouraging because of that fact that I might produce a good rubber by the use of this accelerator.

84. Q. What became of the records you referred to a few questions back as being made at this time?

A. You mean the process?

85. Q. No, with reference to these cures.

A. Why, the slabs of overcured rubber I kept on my desk. I made no written record of it at the time, a reference to these cures.

86. Q. What did you next do with D. P. G. after making this third cure from the original batch?

A. Why, I had no more of the original batch left; it was all used up. So I immediately started on the preparation of some more D. P. G. In preparing D. P. G. at this time, I gained some experience from my two attempts in preparing it, by observing the conditions under which the first two experiments were prepared, and reasoning out from the materials, reacting ingredients that enter into the synthesis of D. P. G. Now, in my first two attempts I used the alcoholic solution of ammonia, and attempted to

dissolve in it thiocarbanilide. I then used letharge to desulphurize, heating the solution at the same time to boiling, while stirring with a glass rod. Now, in this third experiment I realized that ammonia is one of the most important reacting ingredients in this synthesis, and since ammonia was volatile at reaction and temperature, in my succeeding experiment I would either have to use quite a large excess of this ammonia or reduce the temperature of the reaction, and include both conditions in my following experiment. This I did. I used twice the volume of alcoholic ammonia used in the previous experiment, and I desulphurized thiocarbanilid at a lower temperature. In this experiment I obtained a larger yield than I did in the previous two, but not as satisfactory a yield, even from a laboratory point of view.

87. Q. What did you do with the D. P. G. thus obtained?

A. Why, I compounded it into the rubber, using the same recipe I used in compounding the D. P. G. previously obtained, and subjected this compound to vulcanization, in order to arrive at an optimum cure.

88. Q. Did you make the optimum cure the first time you tried?

A. No; the next cure.

89. Q. What was the time and pressure used in this first cure, with the second lot of D. P. G.?

A. I cured one slab for thirty minutes at thirty pounds, and I found that was still overcured, although not to as large an extent as the other cures were, obtained by the first batch of D. P. G.

90. Q. Then what did you do?

A. I cured another slab for twenty minutes at thirty pounds. And I found that this was just about cured up.

91. Q. What was the formula?

A. Why, this slab was taken from the same batch of rubber as I did the previous batch, and the formula of it was 50 parts of rubber, 43 of zinc oxide, 2 of magnesia, 4 of sulphur, 1 of accelerator and one was D. P. G.

92. Q. What was the result of this test?

A. This cure was just about right. I then cured still another slab of the same rubber batch for fifteen minutes at thirty pounds, and I found this to be slightly undercured. I then had this slab of cured rubber tested in a physical laboratory provided for this purpose, and when this was done I obtained a report of the physical tests of the slabs, which showed me that a twenty-minute, thirty-pound was about the right cure. And this test I recorded in the "X" book, a book provided for this purpose in the laboratory, which was kept by me and was in my care.

93. Q. Prior to what date, as you recall, were the unrecorded overcures and the last under-cure tests made?

A. Well, it was prior to the first of the year 1919, when the first overcures were made.

By Mr. Edmonds:

94. Q. Were all three cures made before January 1st?

A. Are you referring to the last three tests or the previous three tests?

By Mr. Wooster:

95. Q. You had several overcures with batches of D. P. G., and I asked you prior to what date were those made, and also the final undercure, with the second batch of D. P. G.

A. My answer is correct.

By Mr. Edmonds:

96. Q. It isn't clear in my mind yet. You have told about making the first slab that was overcured and the second slab that was overcured, and the third slightly undercured. Do you say that all three of these were made before January 1, 1919?

A. No.

97. Q. That is what I understood you were asked.

A. Was that the question?

By Mr. Wooster:

98. Q. Yes.

A. I misunderstood that. These three tests were made some time at the end of January, 1919, and at the beginning of February, 1919, and they were made one after another, that is, probably in a week or so.

99. Q. You mentioned a D. P. G. test which was the first one of which record was made. When was that record made.

A. On February 10, 1919.

Here Court adjourned until tomorrow morning at 10 o'clock, A. M.

Thursday, October 8, 1925.

MORNING SESSION.

MORRIS L. WEISS resumed the stand.

EXAMINATION (Continued)

By Mr. Wooster:

100. Q. At the time of adjournment yesterday you had just mentioned that you recorded your first successful test in the "X" book. Prior to this successful test, did or did you not discuss your work on D. P. G. as a rubber accelerator with anyone else, and if so, give the names.

A. Just before Mr. Clinton A. Carlton left, I pointed out to him that I found guanidine, and told him that we might try this compound, and he agreed with me. When I started to prepare D. P. G. in September of 1918, I spoke to Mr. Munroe H. Daniels, the chief chemist, and told him that I was starting to prepare D. P. G., and I was going to test it as a rubber compound, to see if it was an accelerator. After completing the tests in December of 1918, I showed the rubber slabs, which were cured with D. P. G., to Munroe H. Daniels, chief chemist, and told him of the results that I obtained, and also told him that I was starting to prepare some more D. P. G., in order that I might arrive at an optimum cure with the same.

101. Q. You said Mr. William Holliday made the first cures with D. P. G., which were overcured. Did or did you not tell Mr. Holliday what the ac-

celerator was in this batch of rubber which you first gave him, containing D. P. G.?

A. I do not recall that.

102. Q. Did you afterwards tell Mr. Holliday what accelerator you were using?

A. I told him after I got the optimum cure that that was diphenyl.

103. Q. Diphenyl—what?

A. That is all I told him.

104. Q. When did you tell him that?

A. When I completed the tests in the beginning of February, 1919.

105. Q. Will you please look at the book I show you, and if you recognize it, state what it is.

A. That is the book that I kept at the laboratory, in which I recorded compounding experiments.

By the Court:

106. Q. Is that the book called "X?"

A. Yes.

By Mr. Wooster:

There being another "X" book to be referred to by other witnesses, this book here produced will be referred to as the "2,000 'X' book," and the other book to be later referred to by other witnesses will be the "1700 'X' book."

These books and other records of the Republic Rubber Company are brought here by Mr. Nellen, of the Lee Tire & Rubber Company, the successor of the Republic Rubber Company, and it is asked that photostats of these records may be used in place of the originals, so that

Mr. Nellen may return these records to his files.

107. Q. In addition to this "X" book, were any other records kept of your work on D. P. G. at the Republic Rubber Company?

A. Outside of my personal notebook, no other records of experiments with D. P. G. were kept there.

108. Q. What became of your personal notebook?

A. My personal notebook I used while engaged in the manufacture of D. P. G. in 1920 and 1921, at the plant, and the plant burned down to the ground in 1921, and that notebook was destroyed in the fire.

109 Q. What happened to the samples of rubber which you have testified you made in the latter part of 1918 and the first part of 1919?

A. Those samples I kept on my desk at the Republic, and I took some of them with me when I left there, and when I got to New York I kept them at my house for some time, and then lost sight of them. I didn't know what became of them then.

110. Q. Whose plant was it that burned down in the fall of 1921?

A. The plant of the Dovan Chemical Corporation.

111. Q. Will you please look at the 2000 "X" book, and state whether or not you find any record in it of your work with D. P. G. This book will be marked for identification as Plaintiff's Exhibit No. 2.

A. I do.

112. Q. Please point out those records in full,

giving them in chronological order as far as you can.

A. Here is a record recorded on "X" 2034-E, which is the first successful experiment recorded with the use of D. P. G. The compound consisted of 50 parts of rubber, 1 of D. P. G., 4 of sulphur, 33 of zinc, and 2 of magnesium; vulcanized for 20 minutes, 30 pounds steam pressure; gave a stretch of 14½ inches; tensile strength, 3,000 pounds; a set of ½; recorded on February 10, 1919.

The next experiment was recorded in "X" 2006-G, and consisted of a standard shoddy accelerator recipe, which in this case was 94 parts of "C" shoddy, which is reclaimed rubber; 1 part of lime, 3 parts of sulphur, and 2 parts of D. P. G. There is no record here of the physical properties of this compound, nor the date of it, but there is a note here indicating that it was cured, and the note reads, "Overcured, too much accelerator." This test was made just immediately after the successful tests on the pure rubber, zinc, and so forth, recipe, which was reported on February 10, 1919. This test was made in comparison with a similar test made on July 26, 1918, with T. P. G., and recorded on "X" 2006, column "B."

The next experiment with D. P. G., is recorded on "X" 2006, column "H." This experiment was made with a recipe consisting of 70 parts of "C" shoddy, which is reclaimed rubber, 5 parts of brown crape, which is live rubber, 1 part of lime, 4 parts of sulphur, 2 parts of D. P. G., and 18 parts of barytes. This compound was vulcanized for fifteen

minutes at thirty pounds steam pressure, and gave a stretch of 10¼ inches, tensile strength of 720 pounds, and a set of 5/8, and was recorded on the 21st of February, 1919.

113. Q. Before proceeding further with your answer as to further pages of this "X" book, in connection with the pages previously mentioned by you, and those to be mentioned later, please give in each answer as to each page, in whose handwriting the entries are made which you are reading into the record, and when they were made.

A. The entries I just read were made in my own handwriting, and immediately after I obtained the report from the physical testing laboratory on those compounds referred to. The compound that was not tested in a physical testing laboratory was tested by myself was entered immediately after I made such test; that is, by pulling and feeling it with my thumbs.

The next experiment made with D. P. G. was recorded in my own handwriting, and immediately after I obtained the report of the physical testing laboratory on this compound, in "X" 2042, column "A." This compound, as well as the one recorded on "X" 2006-"H," on February 21, 1919, was a practical factory compound actually used at the plant. This compound consisted of 68 parts of "G" shoddy, which is another grade of reclaimed rubber, 10 parts of hydrolene, which is a pitch, 3 parts of turps, which is crude turpentine, 12 parts of fossil flour, 1½ parts of inertia, which is a lampblack, 2½ parts of lime, 2½ parts of sulphur, and 1 part of D. P.

G. The specific gravity of this compound was 1.60, and was cured for twenty minutes to 274 degrees Fahrenheit, and has a strength of 3½, a tensile strength of 650 pounds, and a set of ⅛. It was recorded on the 4th of March, 1919. This test was made in direct comparison with the actual recipe that was used at the plant at that time, and in which one part of letharge was used instead of one part of D. P. G. Otherwise, the recipe is identical and the specific gravity of that compound was 1.64, showing it was heavier. The cure on that was 38 minutes at 274 degrees Fahrenheit, the stretch was 3½ and the tensile strength was 530 pounds, and the set was ⅛. It was recorded on the 4th of March, 1919, showing it was done at the same time.

114. Q. What was the purpose of making up this compound of turps, fossil flour and the other things mentioned?

A. The Republic Rubber Company had an extensive mechanical rubber goods department, and they were making various mechanical rubber goods, such as baby cab tires and washers and plumbers' supplies, and rubber goods and bumpers and steam packing and rubber hose and in all these compounds which are necessary, inexpensive—cheap—a good deal of reclaimed rubber is used, and the Republic Rubber Company was manufacturing a good deal of the reclaimed rubber they were using, and there was a good deal of interest there in finding an accelerator that would work well with this reclaimed rubber, so that they would get a better compound; that is, a compound that would have a good tensile strength

compared with what they were getting at that time. So these tests were made to see what this accelerator would do, in this shoddy or reclaimed stock, the mechanical goods stock, and for this purpose I tested it out and I found guanidines, and naturally the factory recipe was used at that time, in order to see what it would actually do.

115. Q. Proceed now with further "X" book records, if any, of D. P. G. compounds.

A. Here is a test made of D. P. G. with a compound actually used at the plant, which was steam packing, and here also I wanted to see what D. P. G. would do in the way of improving the quality of this compound. That is recorded in "X" 2010, column "H," in my own handwriting, and the record was made immediately after getting the physical test report from the physical testing laboratory. This compound consisted of 40 parts of batanga, which is a poor grade of rubber, usam—which stands for a shoddy, a trade name for shoddy or reclaimed rubber—11 parts, 15 parts of zingu—which is a good grade of rubber—2 parts of lime, 3 parts of sulphur, 27½ parts of zinc, 1½ parts of inertia, which is a lampblack, and 1 part of Diffendoe," which I used at that time instead of writing out diphenylguanidine —I used this code name.

116. Q. Where did you get these factory compounds which you have referred to in these "X" book tests?

A. From the compounding chemist.

117. Q. Who was that?

A. This recipe I got from Mr. Nellen, who was

the compounding chemist for the mechanical rubber goods department.

118. Q. Why did you get it from him?

A. I talked with him about my work in D. P. G. late in the summer of 1919, and I told him that I had a quantity of pure D. P. G., and I wanted to test it out in as many factory recipes as possible, to show its utility, and I would like to get some compound from him that was used in the mechanical rubber goods department. He gave me this recipe as well as another one for valve stock, that is, a semi-hard rubber valve used in steam valves.

119. Q. Do you recall when you first disclosed D. P. G. as an accelerator in the vulcanization of rubber, to Mr. Nellen?

A. I do. It was some time in August, 1919.

120. Q. Have you any way of fixing that date?

A. It was a few months after he came back to the Republic, as he was away for some time, and I talked to him at his desk. It was pretty warm, and I remember I had my coat off, and that was the time I talked to him about it. That is as near as I can fix the date.

121. Q. Did you ever test any recipe given you by Mr. Nellen with anything else but D. P. G.?

A. Yes.

122. Q. When and with what?

A. With T. P. G. This test was made with the same recipe that I got from Mr. Nellen, and is recorded on "X" 2010, column "G," and is the left-hand page opposite 2010 "H" mentioned just previously. This recipe I got from Mr. Nellen to test D. P. G. I also tested T. P. G. in it, and it was my intention to

test both at the same time. So I compounded the first and for some reason, which I do not now recall, I did not compound D. P. G. at the same time, most probably being called away for some other work, and this test with T. P G. went through before I compounded D. P. G. in the same recipe, which is recorded on "X" 2010-"H." Now, the cure on the compound recorded in "X" 2010-"H," and compounded with D. P. G. was for thirty minutes at thirty-five pounds' pressure, and gave a stretch of 14½ inches, a tensile strength of 2530 pounds, and a set of ½, and recorded on the 29th of September, 1919, in my own handwriting, and immediately after, or soon after, I got the report from the physical testing laboratory on this compound.

Now, the experiment made earlier with T. P. G., is recorded on "X" 2010-"H," the left-hand page facing the page on the right-hand which is also 2010. This recipe consisted of 15 parts of brown crepe, which is a good grade of rubber, 40 parts of batanga, 11 parts of usam, which is the shoddy, 2 parts of lime, 3 parts of sulphur, 27½ parts of zinc and 1 part of "Trifan," which is T. P. G., and ½ part of inertia. This compound was cured for 40 minutes at 40 pounds' steam pressure, and had a stretch of 14 inches, a tensile strength of 1605 pounds, a set of 3/16, and was recorded on September 6, 1919, in my own handwriting, soon after I got a report on this from the physical testing laboratory.

123. Q. Where did you get this formula used in "X" 2010-"H," of September 6, 1919?

A. This is the formula that I got from Mr. Nel-

len, in order to test out D. P. G., to see how it would work in this formula.

124. Q. From where did Mr. Nellen come back?

A. He was in the Army, Chemical Warfare Service.

125. Q. Do you recall when he came back?

A. Yes; he came back in the spring of 1919, late in the spring of 1919, or early in the summer of 1919.

126. Q. Will you now compare the test on Trifan, "X" 2010-"H," of September 6, 1919, with the test on Diffendoe, "X" 2010-"H," of September 29, 1919, and state what those figures tell you as to the action of T. P. G. and D. P. G. on those compounds. I have referred to two columns "H." The first one means the left-hand page, and the second "H" means the right-hand page.

A. The compound vulcanized with D. P. G., recorded on the 29th of September, 1919, was vulcanized in a shorter time and at a lower temperature or steam pressure, had a better stretch and a much better tensile strength, and the amount of accelerator used in both compounds was the same. Now, this test of September 6, 1919, I got before I made this test with D. P. G. on September 29, 1919, and noticing the low physical properties I got on this compound, I made another comparison at the same time I compounded D. P. G. in this recipe, with T. P. G., using a larger quantity of T. P. G. This experiment is recorded on "H" 2010-"H," right-hand page, and consisted of 40 parts of batanga, 11 parts of usam, 15 parts of brown crepe, 2 parts of lime, 3 parts of sulphur, 26½ parts of zinc, 2 parts of T. P. G. and half a part of inertia. The cure on that was 40 minutes, at 40 pounds' steam

pressure, the same I had in the experiment reported on September 6, 1919. The stretch on this was 13¾, the tensile strength was 2105 pounds, the set was ½, and it was recorded in my own handwriting on September 29, 1919, soon after I got the physical test report from the physical testing laboratory.

127. Q. Up to September, 1919, had you considered D. P. G. as an accelerator in the curing of rubber, for anything else than the compounds you have mentioned?

A. I don't quite understand what you mean by that question.

128. Q. Have you named all the compounds in which D. P. G. was to be used as an accelerator?

A. To be used?

129. Q. Up until September 1, 1919.

A. Yes; I mentioned all the compounds in which I found guanidine was used.

130. Q. I do not mean all in the "X" book. Did you have any others in your mind, up to September, 1919?

A. Yes.

131. Q. What?

A. I reported or made tests with D. P. G. of various purities. In the experimental work in getting D. P. G. it wasn't always obtained in a pure form, and it required purification. Now, it occurred to me to test D. P. G.'s containing these impurities, which are manifested by the lowering of the melting point, as a pure chemical generally has a sharp melting point, and any impurities that may be present generally lower the melting point. Now, it was my idea to see what these several D. P. G's, obtained from

several experiments, that had different melting points, to see what results I would get in the rubber by actually testing those, that is, compounding a number, and see what results I would get. This I did late in the summer of 1919.

132. Q. You misunderstood the question. I am asking you if, prior to September 1, 1919, you had any other compounds in your mind, to use D. P. G. in, that are not in the "X" book pages you have referred to?

By Mr. Edmonds:

That is objected to on the ground that it is utterly immaterial. What this witness says now from memory that he had in mind six years ago, it seems to me would be utterly valueless.

By the Court:

It might be admissible. We will allow that question to be answered.

A. I purified some hundred grams of D. P. G. some time in August of 1919, and it was my intention to make tests of that purified D. P. G. with a number of factory recipes, to see what D. P. G. would actually do in the way of improving the rubber compound.

133. Q. Can you give any other factory compounds in which it was contemplated to use D. P. G., other than those you have given?

A. Yes. I was planning to test that in the pure gum, inner tubing, to test it in a friction stock, friction for belting or friction stock for tires, and also I was planning to test it in a hose stock; that is, the rubber covering the hose, and the valve stock and a

number of other stocks that I would get from time to time.

134. Q. Were any other uses for D. P. G. in rubber compounds suggested to you?

A. Oh, yes.

135. Q. What?

A. I remember that distinctly. It was in the summer of 1919, and after I told Mr. Daniels that I had prepared D. P. G. and after I tested it I found guanidines, and I had some of that left. I told him that if he would want to have that tested by himself and in some of his own compounds, I would let him have some of the D. P. G. Now, it was in the summer of 1919 that he told me he would like to test out D. P. G. in an inner tube splicing cement, that is, a compound used in splicing inner tubes, that is, putting both ends together and sealing them up. I told him "Fine!" And he told me that I should give some of this D. P. G. to William Holliday, who was in the experimental mill room, doing the work there, and that he would use that in compounding the splicing cement. This I did, and it seems that they used that up quickly, because he came back for another portion of D. P. G., which I gave him.

136. Q. How do you fix that date as the summer of 1919?

A. It was after I came back from Pittsburgh, where I visited the Carnegie Institute Library and got some more information on the methods and also on the theoretical considerations of D. P. G., and after I made a number of experiments duplicating or verifying the methods recorded in the literature, several months, or three months after I made the tests with

D. P. G., and recorded, in this "X" book, the first few tests that I made.

137. Q. Did you finish your comparison of the T. P. G. test on "X" 2010, left-hand page, and the test on the right-hand page of the same number?

A. No.

138. Q. Please finish that answer?

A. There were two compounds with T. P. G. made up at that time, in comparison with the one of D. P. G. recorded on "X" 2010-"H," right-hand. The first one, which has already been referred to, is recorded on "X" 2010, column "F," right-hand, while the second one in comparison is recorded on "X" 2010, column "G," and consisted of the same recipe as the one in column "F," with the exception that no lime was used, and instead of two parts of lime, two parts of zinc were added to the zinc already used. Now, this compound was cured also for forty minutes at forty pounds' steam pressure, and gave a stretch of 13¼, a tensile strength of 2075 pounds, and a set of 9/16. That was recorded in my own handwriting on September 29, 1919, as soon as I got the physical test report from the physical testing laboratory.

139. Q. Please now continue with the experiments shown in the "X" book on D. P. G., subsequent to the one you have just referred to, and continue the same answer.

A. The next is 2064, column "D," where the experiment is recorded, which consisted of 50 parts zingu, 1 part Diffendoe, which is D. P. G., 4 parts of sulphur, 43 parts of zinc, and 2 parts of magnesia. This compound was cured for thirty minutes at thirty

pounds' steam pressure, and gave a stretch of 14 inches, a tensile strength of 2790 pounds, and a set of 3/8. It was recorded in my own handwriting on October 3, 1919. This experiment was carried out in comparison with another one in which 1 part of lime was used instead of 1 part D. P. G., and that 1 part of lime was recorded on "X" 2064-"E." It was cured for seventy-five minutes at forty-five pounds' steam pressure, and gave a stretch of 11½ inches, a tensile strength of 1810, and a set of 3/16. It was recorded on October 3, 1919, in my own handwriting, as soon as I got the physical test report from the physical testing laboratory.

"X" 2066, columns "O," "A," "B," "C," "D" and "E," is a record of compound experiments made with D. P. G. of various purities. Column "O" was cured with D. P. G. melting at 140 degrees Centigrade. Column "A" was cured with D. P. G. melting between 1:30 and 1:40 degrees Centigrade, and these were compared with D. P. G. of a higher melting point, such as between 145 and 147 Centigrade, which is the melting point recorded in the literature for a pure product. These tests were made in the summer of 1919.

By Mr. Edmonds:

140. Q. These tests on 2066?

A. Yes.

141. Q. These undated tests?

A. Yes.

142. Q. Made in the summer of 1919?

A. Oh, yes.

143. Q. On this page 2066?

A. Oh, yes.

144. Q. They follow tests on the preceding pages dated in September and Octboer?

A. Yes.

145. Q. And are immediately followed by other pages in October, November and December?

A. Well, I don't know what followed there.

By Mr. Wooster:

I object to Mr. Edmonds' questioning the witness now.

By Mr. Edmonds:

I apologize. It was so extraordinary that I couldn't let it pass.

By Mr. Wooster:

146. Q. Go on.

A. I evidently didn't have these tested in the physical testing laboratory, but I was contented with testing it by pulling the rubber slab, pulling it and feeling it, to see which ones were cured right; that is, whether the physical properties of one were much different than the physical properties of the other; that is, the ones with the pure compound.

"X" 2059, columns "D" and "E."—I made tests with D. P. G. that I prepared by an improved process, and I found that in some of the experiments that I made, the D. P. G. contained lead or litharge in it that got in there in the process of making it, and I determined the quality of this amount in the D. P. G. by burning a definite quantity and burning off the organic matter that would burn, and the litharge remained that wasn't burned as an ash, and I determined the percentage or quantity of this litharge and

D. P. G., and I compared this D. P. G. containing the litharge.

"X" 2059-"E" is a compound containing this D. P. G. which has 3½ per cent. of this litharge. Now, this was vulcanized, both "D" and "E" were vulcanized, for twenty minutes, at thirty pounds, and the stretch was 14¼ inches on both of them, and the tensile strength was 3400 pounds on both of them, with a set on "D" of ¾ of an inch, and that on "E" was ⅝. These were recorded in my own handwriting on the 12th of October, 1919, soon after I got the physical tests' report from the physical testing laboratory.

On the same page, columns "F" and "G," I tested D. P. G. of various purities, that is, "F" giving a melting point of 120 degrees Centigrade, and "G" giving an ash of 1.9 per cent, and a melting point of 140, showing that this D. P. G. was also made during the time I was working with this improved process and records were made in my own handwriting on November 9, 1919, soon after I got the report from the physical testing laboratory.

147. Q. How did the improved process that you have just referred to differ from the one described by you yesterday, with which you made your first D. P. G.?

A. Instead of using ammonia as one of the ingredients necessary, I used salt of ammonia, such as ammonium nitrate.

148. Q. When did you first obtain ammonium nitrate for this purpose?

A. There was some ammonium nitrate in the

laboratory, but I subsequently, in the summer of 1919, got a five-pound bottle of ammonium nitrate.

149. Q. What did you do with it?

A. I used some of it; the rest of it would remain.

150. Q. From October, 1919, on, what was your work at the Republic Rubber Company?

A. The same as it was before; outside of the routine work, any spare time I had was used in finding out this process for making D. P. G. and things like that.

151. Q. What was the condition of this company at that time, after October, 1919?

A. The condition was the same to me. After the first of the year 1920, in February of 1920, I learned that there was a financial crisis with the Republic, and that most of the men in the laboratory were to be allowed to go.

152. Q. What did you then do?

A. I finished up some of the work, and I left the Republic in March of 1920.

153. Q. What did you then do?

A. Just before I left the Republic, I made two trips to Akron and tried to interest some—in fact, all—of the large rubber manufacturers there in the use of D. P. G.

154. Q. Did you have any success?

A. No.

155. Q. What did you then do?

A. I then went to New York, it being my wife's home, and I lived in New York for some time, and while there I tried to interest some chemical manu-

facturers in the way of manufacturing D. P. G. and offer it to the rubber trade.

156. Q. What was the result?

A. No success there either until I visited the supply house that supplied the rubber manufacturers with various ingredients necessary for their manufacture. Now, I knew of this supply house, because we used to get some of the materials when I was at the Republic, from them, such as golden antimony. That was the States Metals Company, and the chemist of that company, Mr. H. S. Doty, visited the Republic Rubber Company while I was there, and I came to know him. So I went up to see him while I was in New York, and I talked with him about this accelerator that I had. I had a sample of it with me, and asked him to try it out for himself, and gave him a formula for trying it out, which he did.

157. Q. When was this?

A. This was early in April of 1920.

158. Q. At this time what were your financial means?

A. Not very good. I was married and just had a child then and I had to get into something to have enough means to live by, and I was anxious to do something, because I was pretty well in need of something to do.

159. Q. Did you tell Mr. Doty the name of the accelerator which you gave him?

A. No.

160. Q. Did you afterwards tell him the name of it?

A. Yes.

161. Q. What did you then do?

A. We made sort of a partnership agreement, whereby I would manufacture this D. P. G., and they were to finance it and offer it to the rubber trade, and sell it as an accelerator vulcanizer.

162. Q. Did they do that?

A. Yes.

163. Q. When did they commence?

A. In the summer of 1920.

164. Q. Did you have a plant?

A. Yes.

165. Q. What were you doing between the time you signed up and when you first put some out?

A. We looked around for a plant at the beginning, and finally located one in Brooklyn. There was some equipment there, and we put in additional equipment that was necessary, and I started then the first two batches, and by August, 1920, we had some finished product.

166. Q. What was this product called?

A. We gave that the trade name of "XLO."

167. Q. What was the composition of this material?

A. It consisted of two-thirds of D. P. G. and one-third of calcined magnesia.

168. Q. What was your position after that?

A. I was manufacturing this stuff.

169. Q. Where?

A. At the Brooklyn plant, at the beginning, and after that we got a plant manager. I was chief chemist and doing research work.

170. Q. When was the plaintiff incorporated, if you remember?

A. In February or March of 1921.

171. Q. Did it succeed the partnership?

A. Yes.

172. Q. When was the fire, to which you previously referred?

A. In September, 1921.

173. Q Where was the plant that burned?

A. In Brooklyn; 980 East 35th Street.

174. Q. Can you state when regular commercial production of D. P. G. had commenced?

A. In August, 1920.

175. Q. Was it in production at the time of the fire?

A. Yes.

176. Q. What did you do then?

A. We looked around immediately for a plant and located one in Newark, New Jersey.

177. Q. Did you get it?

A. Yes.

178. Q. When did you start it?

A. We started and began commercial production in December, 1921, December and from then on, in 1921, a couple of months right after the fire. It took us that long to rig up the plant and get things in shape.

179. Q. Did plaintiff, on the commencement of its manufacture, always sell this "XLO"?

A. No.

180. Q. What did it sell?

A. Diphenylguanidine afterwards.

181. Q. Pure or impure D. P. G.?

A. Commercially pure.

182. Q. What purity is that?

A. 98 to 99 per cent.

183. Q. You stated yesterday that you had other duties at the Republic during 1919, besides investigating accelerators. Did you make reports of such work?

A. Yes.

184. Q. Can you identify the reports if shown you?

A. Yes.

185. Q. Will you please look at the papers I show you and state what they are?

A. This is a report of comparative tests of different grades of thiocarbanilid, dated March 22, 1919, and signed "M. L. Morris, Chemist." This is a report of a comparison of flakso, in which the aluminum flake was substituted with magnesia, dated February 24, 1919, signed M. L. Morris. This is a report of analysis of paraphenylenediamine, obtained from the National Aniline Chemical Company, and signed by me, dated June 28, 1919. This is a report of results obtained by incorporating hexa, which was an accelerator used there at that time, and No. 6 cement, a certain cement used at that time, dated May 9, 1919, and signed by me.

186. Q. Are these all of such reports that you made during the period of your employment, or only examples?

A. I made quite a number of reports. These are only part of the reports that I made, or examples of such reports.

By Mr. Wooster:

I offer in evidence these four sheets as Plaintiff's Exhibit No. 3, Samples of Weiss Reports, 1919.

By Mr. Edmonds:

Objected to as irrelevant.

By the Court:

The objection is sustained and an exception noted to plaintiff.

CROSS-EXAMINATION.

By Mr. Edmonds:

X187. Q. You heard the testimony of Mr. Whitby yesterday. Do you agree with him as to all of the statements that he made in his testimony?

By Mr. Kennedy:

That is objected to.

Objection sustained.

By Mr. Edmonds:

X188. Q. You heard Mr. Carlton's story of the details of your claim of conception of this idea of using D. P. G. Do you accept that as your story, or must we go through that again?

By Mr. Kennedy:

Objected to.

Objection sustained.

By Mr. Edmonds:

X189. Q. When you were with the Republic Rubber Company you had had no experience whatever in the chemistry of rubber?

A. No.

X190. Q. And you started work under Carlton?

A. I did.

X191. Q. You came to know that Carlton had been working with T. P. G.?

A. He told me that.

X192. Q. And he mentioned to you the guanidines as a class of substances that might be accelerators?

A. It was discussed in general.

X193. Q. Did you come to know also that basic substances were accelerators, or rather that it was a fairly well established rule that to be an accelerator a substance had to be a basic substance?

A. Yes; from my experience during this time.

X194. Q. You mean you learned that by experience and not by reading?

A. By reading and by experience.

X195. Q. You got that from the literature?

A. I knew that magnesia and lime and litharge could be used for the vulcanizing of rubber, and those are basic substances, inorganic bases.

X196. Q. An accelerator, of course, cuts down the time of vulcanizing. Did you come to know from your association with Carlton, or otherwise, that in cutting down the time of vulcanizing by the use of an accelerator, the strength and elasticity of rubber would be improved?

A. That depends on the accelerator.

X197. Q. You didn't learn from Carlton that that was a fairly general rule?

A. No.

X198. Q. Carlton didn't tell you that?

A. No; he didn't tell me in those words.

X199. Q. Did he tell you that in substance?

A. No. It wasn't entirely as to time; it was

also with reference to the temperature or pressure used.

X200. Q. If the accelerator reduced both, either or both the time or temperature, then the quality of the rubber would be improved?

A. Not necessarily; not always. That was from my judgment in the use of accelerators, that it didn't always happen.

X201. Q. But a fairly general rule was to use organic accelerators?

A. I didn't know of any rule except the discussions I had with Carlton, and I don't know how general that was.

X202. Q. Did you know that monophenylguanidine was more basic than D. P. G.?

A. No, sir.

X203. Q. You didn't see monophenylguanidine in Richter's book?

A. No, sir.

X204. Q. What happened was that you had occasion to refer to Richter's book at the point giving certain data with respect to T. P. G., and you saw there on that same page D. P. G.?

A. I referred to Richter's book at that time quite often, because I was assisting Mr. Carlton in the preparation of some of these compounds, and I familiarized myself with the chemistry of these compounds very thoroughly, quite in detail.

X205. Q. By way of answering the question, on that same page with this data about T. P. G., you found similar data with respect to D. P. G.?

A. Yes; I looked up in the book the nature of

aromatic substituted guanidines, and I saw D. P. G. there.

X206. Q. Going on to a time a little later in point of time, you stated in the National case that you were away on a vacation during the first half of June, 1918, and that then you found that you had recorded many experiments in the "X" book during that first half of June, 1918. Is it still your testimony that you were away from the Republic plant the first half of June, 1918?

By Mr. Wooster:

I object to the counsel stating what the witness testified in the other case. It is entirely too general.

By Mr. Edmonds:

X207. Q. Did you take your vacation in the first half of June, 1918?

A. To my best recollection, I had my vacation in June, 1918. I do not recall exactly whether it was the first week or the last week in June, but it was some time in June, 1918.

X208. Q. Was it one week?

A. No; it was two weeks.

X209. Q. And you don't know when it was in June?

A. I do not recall that exactly.

X210. Q. Don't you recall that you undertook to state very definitely when it was—in the National case?

A. I don't recall, but my best recollection now is that it was some time in June that I took my vacation and went to New York.

X211. Q. Do you recall whether you stated the exact date when you got back, in the other case?

A. I believe I did, and corrected myself there.

X212. Q. You stated, did you not, that you were away the first two weeks, and that you got back on the 16th, having missed the train on which you expected to get back on the 15th?

A. It is my best recollection now that my vacation took place in June; some time in June of 1918.

By the Court:

213. Q. Counsel didn't ask you that. He asked you whether you testified that or not, at the trial of this other case.

A. I believe I did.

By Mr. Edmonds:

X214. Q. And then it appeared on examination of this book before you that many experiments were recorded in your handwriting, and dated in the first half of June, 1918?

A. Yes.

X215. Q. Now, a little later, in 1918, you say that you made some D. P. G. and produced an amount of about five ounces?

A. Five grams.

X216. Q. And that was perfect, the perfect melting point, wasn't it?

A. Yes; according to my test.

X217. Q. The first time you got a perfect property?

A. Yes.

X218. Q. And you made that up into a rubber compound?

A. Yes.

X219. Q. And with that compound you produced three vulcanized slabs?

A. I did.

X220. Q. Can you, in view of those facts, account for the fact that you stated in the affidavit which was filed in the National Aniline suit that the amount of D. P. G. that you made at that time was not sufficiently large to permit you to make a test of any kind? Have you any explanation for that?

A. I don't recall this at all. I would like to see it and see how the expression of it is.

X221. Q. What is your testimony now as to what you did with those three slabs that you made?

A. I had them tested, those three slabs. I didn't do anything except testing it with my tongue, and cutting with scissors, and pulling it, and after I did that I showed them to Mr. Daniels.

X222. Q. When was that?

A. That was in December, 1918.

X223. Q. That is not in strict accord with the testimony you gave in the National case, is it?

A. I don't recall that.

X224. Q. You don't recall that you said at one time that you told no one at all?

By Mr. Kennedy:

The best evidence of what he said is the affidavit itself, it seems to me.

By the Court:

You can ask him this question. I suggest, however, if it is for the purposes of contradiction, you had better call his attention to the specific

time and place and person, or the specific affidavit.

By Mr. Edmonds:

X225. Q. I read from your testimony in the National case: "Q. 61. That was a rubber compound you used diphenylguanidine with? A. Yes. By the way, before you go on with that,"—this is referring to those three slabs you say you made in December, 1918. "Q. 67. By the way, before you go on with that, did you inform anybody about the plant as to these efforts you were making to get diphenylguanidine? A. No one at all. Q. No one knew it? A. No one knew what I was doing?"

A. This question refers to the plant, and the way I understood it then, I did not tell anyone in the plant. It does not refer to the laboratory, and that is the way I understood the question at that time.

X226. Q. When you said, "No one at all, no one knew what I was doing," you meant no one in the plant, but you did not mean no one in the laboratory?

A. Yes.

X227. Q. After those three slabs were made from that five grams, you proceeded to make some more D. P. G., and in that effort you produced about 25 grams?

A. I did.

X228. Q. When was that done?

A. That was done immediately after I got these over-vulcanized slabs of rubber in December of 1918, and carrying it over a few days into January of 1919.

X229. Q. It took you some little time to do that, part of December and part of January?

A. It didn't take me very long then, I being familiar as to the handling of ingredients and applying every effort to get it done, after I was interested in the results.

X230. Q. Let us see if we can fix the time somewhat more definitely. Do you recall any trip you made about that time?

A. I did.

X231. Q. Whereabouts?

A. That was in January of 1919.

X232. Q. A trip where?

A. To the Carnegie Institute Library at Pittsburgh.

X233. Q. About how long a time on that?

A. Three days.

X234. Q. Can you fix the time of the trip?

A. Not definitely, but it was in the first part of January, 1919.

X235. Q. The first week?

A. Either the first or second week; I do not recall exactly.

X236. Q. Was this 25 grams of D. P. G. made before or after that trip?

A. Before.

X237. Q. When did you make your next supply of D. P. G.?

A. I started in March or the end of February. I started again to make some D. P. G. according to the methods I obtained from the Pittsburgh Library.

X238. Q. That 25 grams was what you used in making these slabs that you refer to as having been

made in the latter part of January or early in February, including the two shoddy compounds. That is correct?

A. Yes. Four compounds I had.

X239. Q. You are quite sure that you made this 25 grams of D. P. G. before this Pittsburgh trip?

A. Yes.

X240. Q. Have you any way of accounting for the fact that you signed an affidavit in the National case, in which you state the contrary of that, that the 25 grams was made after your return from this Pittsburgh trip?

By Mr. Kennedy:

I object to the assumption that there is any such affidavit or that the witness has made any such statement.

By the Court:

Ask him if in any particular affidavit, at a particular time, for use in a particular case, he didn't say thus-and-so.

By Mr. Edmonds:

X241. Q. I hand you a certified copy of an affidavit which I believe you executed on June 12, 1922, which was used in connection with a motion for preliminary injunction in the suit brought on the patent here in suit by the National Aniline Chemical Company. Will you state whether or not you signed the original of it?

A. Yes.

X242. Q. That is a copy of your affidavit?

A. Yes.

X243. Q. In this affidavit, after referring to conceiving this idea of using D. P. G. in 1918, and so forth, you say, "In June, 1918, I took my vacation, and went to New York and visited the New York Public Library at 42nd Street and Fifth Avenue, to look up various questions relating to accelerators, such as their poisonous nature and other questions. This was at the request of Mr. Munroe H. Daniels prior to my leaving on my vacation. Having had diphenylguanidine previously in mind, I particularly noted references to the same when looking for publication relating to triphenylguanidine, para———, etc. As a result of this examination at the New York Public Library, I found very little literature on diphenylguanidine, but found sufficient data to enable me to prepare a small quantity of diphenylguanidine, which I did during the month of September, 1918. The quantity prepared at that time was not sufficient to permit a test in a rubber compound." That last statement you say now is untrue, don't you?

A. When was that prepared, in September?

X244. Q. September, 1918, and I refer to the statement that the quantity produced at that time was not sufficient to permit the test of a rubber compound. Is that the statement you say now is untrue? Do you say now that that statement is untrue? I ask you if that statement is considered by you to be in harmony with the testimony that you have given here yesterday and today?

A. No.

X245. Q. Which is right—this affidavit or your testimony of yesterday and today?

A. The testimony is right.

X246. Q. Of yesterday and today?

A. Yes.

X247. Q. That is right and the affidavit is wrong?

A. It is not entirely wrong—If you want me to explain it.

X248. Q. The affidavit that I refer to continues: "During my conversation with Mr. Daniels in the month of September, 1918, I mentioned to him my tests in triphenylguanidine, and advised him that I also desired to try diphenylguanidine to ascertain whether it would be a good accelerator, and told him that I was at that time trying to produce a sufficient quantity to test it in a rubber compound in the laboratory. At that time I did not have sufficient data to produce any considerable quantity of diphenylguanidine. Then in January, 1919, I visited the library of Carnegie Institute, at Pittsburgh, Pennsylvania, and went through the literature on this subject. As a result of this investigation, I found descriptions of various processes for making diphenylguanidine by laboratory methods, and upon my return to Youngstown, Ohio, about the middle of the same month, January, 1919, I prepared sufficient diphenylguanidine and tested it soon thereafter in a rubber compound." Do you find that to be consistent with the testimony you gave here yesterday and today?

A. Yes.

X249. Q. Including the statement here that this D. P. G. was made after your return from this trip

to Pittsburgh, where you investigated the literature of D. P. G.?

A. You mean the description—

X250. Q. The affidavit states you made this second batch after your return from the trip here to study the literature?

A. It doesn't state that to me.

X251. Q. Let us read it again: "As a result of this investigation, I found descriptions of various processes for making diphenylguanidine by laboratory methods, and upon my return to Youngstown, Ohio, about the middle of the same month, January, 1919, I prepared sufficient diphenylguanidine and tested it soon thereafter in a rubber compound." Isn't that inconsistent with what you stated a few minutes ago?

A. It says rubber compounds, but it doesn't say these tests I made was with a diphenylguanidine produced before or after I went to Pittsburgh. I made all the tests later on, and this may refer to the other tests.

X252. Q. Your explanation isn't entirely clear to me. This affidavit, as I understand it, states that you made some diphenylguanidine in 1918, but it was insufficient for a test, and then you came down here to Pittsburgh and read the literature here, and that enabled you to go back to Youngstown and make another batch of this D. P. G., and that, I understand, is inconsistent with the testimony that you gave here this morning.

A. No, I don't read the affidavit that way. It is

in general terms there. It doesn't give specific data or details.

X253. Q. It says "Upon my return to Youngstown, I prepared sufficient diphenylguanidine and tested it soon thereafter in a rubber compound."

A. That is correct. That says in the previous part of that affidavit that I did not prepare a considerable quantity, see? It refers to a considerable quantity, and for that reason I went to Pittsburgh to familiarize myself more in detail with the methods of preparation, and when I returned I started, and thereafter at my leisure, whenever I had time to do it, I started experiments in making more diphenylguanidine, which I did, and tested it thereafter.

X254. Q. Try to be more specific about these things, instead of dismissing them in general terms. You said this morning that you made this second batch of 25 grams before going to Pittsburgh to consult the literature in the Carnegie Library?

A. That's right.

X255. Q. You still stick to that?

A. Oh, yes.

X256. Q. And if the affidavit is inconsistent with that, the affidavit is wrong?

A. If it is inconsistent, but I don't see the inconsistency.

By Mr. Edmonds:

I will now offer the affidavit in evidence, this being a certified copy of the original on file in the New York Court, and acknowledged by the witness to be a copy of his affidavit.

By Mr. Kennedy:

Objected to.

By the Court:

If it is objected to at the present time, in view of the fact that we are now hearing the plaintiff's case, I sustain the objection, with permission to counsel, of course, to offer it when his time comes for the introduction of it.

By Mr. Edmonds:

If that is the only objection, I will have it marked for identification and offer it later.

By the Court:

The affidavit can be introduced for the purpose of showing a contradiction of testimony of those parts. We will not rule upon that now.

RECESS.

AFTERNOON SESSION.

Thursday, October 8, 1925.

MORRIS L. WEISS resumes the stand.

CROSS-EXAMINATION (Continued)

By Mr. Edmonds:

X257. Q. You said something this morning to the effect that one of the compounds that you referred to in the X-book, with D. P. G. in it, was actually used in the Republic plant. You didn't mean by

that that it was used in the manufacture of articles for sale, did you?

A. The type of compound was used, but not the one that I have recorded there.

X258. Q. And no one with D. P. G. was used in that winter of 1919-1920?

A. No, sir.

X259. Q. And what you meant by putting the D. P. G. compound into the compounding room was something other than commercial manufacture?

A. Oh, yes, it was an experimental test.

X260. Q. Prior to that you had made your experiments in the laboratory and then you put this compound into the compounding room for further experimental work there?

A. No, sir.

X261. Q. Well, will you state what the fact was?

A. I selected this type of compound and compounded that in the laboratory to see just what effect D. P. G. will have on that compound. It was not used at that time.

By the Court:

X262. Q. You mean the compound with some other accelerator was being used, and you simply took the formula?

A. That is right.

By Mr. Edmonds:

X263. Q. Now you said something about putting the formula that had the D. P. G. in it into the compounding room. What was that done for? What did you mean to convey by that?

A. I don't recall making such a statement.

X264. Q. Well, you started to apply the name "Diffendoe" to D. P. G. What was the occasion for that?

A. The occasion for that was that after I experimented with diphenylguanidine, and found that it was of value, I ascribed to it a code name, so that eventually, if this accelerator would get into the compound room it would be used under that code.

X265. Q. Well, it was used in the compounding room, and there the name of "Diffendoe" was used instead of C. P. G., isn't that correct?

A. No. I compounded that myself. I used the experimental room to do it in, but D. P. G. wasn't actually used in the compound room for any other purpose or for any other compounds.

X266. Q. But the formula was known in the compounding room, wasn't it?

A. The formula was known in the compounding room, but with a different accelerator.

X267. Q. With "Diffendoe" used instead of "D. P. G.?"

A. Yes, but that formula was used with another accelerator, and I simply got this type of accelerator.

X268. Q. When was it you started to use the name "Diffendoe?"

A. That was later in the summer—or in the summer of 1919.

X269. Q. Now, you say you told Mr. Daniels something about D. P. G. He was the first person that you told anything about it to, wasn't he—that is, the first after Mr. Carlton?

A. Yes.

X270. Q. And who was the next after him?

A. Mr. Nellen was the one that I spoke to about diphenylguanidine in the laboratory.

X271. Q. Next after telling Mr. Daniels about it?

A. Mr. Nellen was the next after telling Mr. Daniels in the laboratory.

X272. Q. He was the next person in all the world—not in the laboratory—he was the next person that you told about D. P. G.?

A. No.

X273. Q. Well, who was?

A. Dr. Harvey Seil, chief chemist of the Youngstown Chemical Company.

X274. Q. When did you tell him about it?

A. I told him about it in the early summer of 1919.

X275. Q. And who was next after him?

A. Dr. I. Greenwald, who was my chief in the Harriman Research Laboratory, and he was a lieutenant in the U. S. A. Sanitary Corps in the summer of 1919; and I wrote a letter to him—I understood that he was working with some guanidines in his experimental work.

X276. Q. When did you tell him?

A. That was in the summer of 1919. I wrote him a letter stating that I prepared some pure diphenylguanidine and triphenylguanidine, and asked him in that letter if he would like to have some in his experimental work, that I would send him some.

X277. Q. And who was the next one after him?

A. About the same time I spoke to Mr. Nellen with reference to diphenylguanidine and asked him to give me some type compounds so that I could test that D. P. G. out.

X278. Q. Then when you told Daniels about it in 1918, you never spoke to anyone else about it until along in the summer of 1919, when you spoke to this man Seil?

A. That is correct.

X279. Q. You kept it to yourself all that time?

A. That is correct.

X280. Q. Could you fix any more accurately than you have when it was that you applied the name of Diffendoe to D. P. G.?

A. It was at the time that I got the type recipe from Mr. Nellen.

X281. Q. And that was the occasion for applying this new name to it, wasn't it—because that recipe that you had got you used under conditions such that other people would know about it?

A. Why, it would eventually be used under conditions that other people may know about.

X282. Q. So you wanted to use a name which would not indicate exactly what this chemical was?

A. That is right.

X283. Q. And that was how you came to use the name Diffendoe, and you applied it to this D. P. G. in this formula that you got from Mr. Nellen?

A. That is right. I used the code names for others. Triphenylguanidine I called "trifan," under similar conditions.

X284. Q. You recall, do you not, that in the National case you stated that you never told anybody about this diphenylguanidine except Mr. Daniels until you applied the name of Diffendoe to the D. P. G. and put the compound with Diffendoe in it into the compounding room?

A. I believe that was in answer to a question whether I told anybody in the plant, or anyone like that.

X285. Q. Well, let us see if it was. One of the questions put to you in the National case was this: "You said yesterday that no one knew what you were doing, and then immediately after you said that after you had gotten results from it,—'That is, when I incorporated the D. P. G. into the rubber, no one was informed until after I had actually gotten the rubber slab and found how it worked, then I informed Mr. Daniels.'" And you said, "Yes, I said that. I meant no one else with the exception of Mr. Daniels. Yes, I kept that work to myself not alone in 1918, but a good part of it in 1919. I had to use D. P. G. in the compounding laboratories, when I gave it a code name. Up to that time, no one was informed of my work with D. P. G. with the exception of Mr. Daniels." You recall that, don't you?

A. That referred to the plant or compounding room.

X286. Q. Oh,—there was an exception there that does not appear in your answer. Is that right?

A. I didn't understand that.

X287. Q. You mean to make an exception which is not stated in that answer?

A. Which answer?

X288. Q. The answer I just read to you. Well, never mind that. State where Mr. Daniels was. Was he in the laboratory or in the plant?

A. Why, he was in the laboratory and around the plant. He was the chief chemist. He was my superior.

X289. Q. So when you say that no one was informed of your work, you mean to say no one in the plant. You do not mean by that to exclude everyone, including those in the laboratory. Is that correct?

A. That is correct in so far as it goes to my 1918 and early 1919 experiments.

X290. Q. Now, will you state why you did not record these experiments that you say were made in 1918 in this "X" book?

A. Because I did not consider them complete experiments.

X291. Q. The X-book was kept there as a book in which to record experiments made by the chemists, made in the laboratory; was it not?

A. Those at his discretion were to be put in, that he wanted to put in.

X292. Q. Oh; it was entirely up to you whether to put anything in there or not?

A. Oh, yes.

X293. Q. But many experiments were recorded that were over-cured, were there not?

A. Yes.

X294. Q. And they would serve to show anyone coming along later that that compounding cure would over-cure, so that he wouldn't make that same mistake?

A. I don't know how much it would show to one coming along later, but there was a reason for putting in over-cure in that experiment at that time.

X295. Q. But even so, you didn't record these three experiments in 1918?

A. No; I didn't record it, for the reason that I did not consider them complete, and I expected to complete them and record them then.

X296. Q. As I recall, you said in the National case that it was your duty to record all experiments?

A. It was at my discretion entirely.

X297. Q. You recall, do you not, that in the aniline case some of the other ex-employees of the Republic Company said it was the rule that all experiments should be recorded in the X-book?

A. I recall they said that, but it was not my understanding at the time I took charge of the laboratory. In fact, I don't know of any rules existing at all; I don't know of any rules. I wasn't given any rules.

X298. Q. This test in the X-book, to which you have referred, in column E, on page 2034, you of course agree that the date there has been changed?

A. It looks that way.

X299. Q. Did you make the change?

A. I most probably did; yes.

X300. Q. Now, during this time, that is, through 1919, more particularly the early part, there was considerable work going on at the Republic plant with T. P. G., was there not?

A. In the early part, you say?

X301. Q. Through 1919, the first six or eight months of 1919?

A. In the early part there wasn't much work done in T. P. G. at the plant.

X302. Q. Wasn't there an effort made to develop a commercial process for the manufacture of T. P. G.?

A. That is true; yes.

X303. Q. And a semi-commercial plant was built for that purpose?

A. It was started.

X304. Q. You worked directly on that, didn't you?

A. I didn't work on the plant.

X305. Q. No; on the development of the process and the starting of commercial manufacture?

A. No. I developed that in the laboratory, and after doing that I consulted with the man who was to put up that semi-commercial plant.

X306. Q. Well, wouldn't you say that you worked on that more than anything else during the first eight months of 1919?

A. Oh, no.

X307. Q. The idea was to develop that commercial plant to the point of manufacturing the T. P. G. used in the Republic plant?

A. That was the idea.

X308. Q. The plant was to use that accelerator more than any other?

A. I wouldn't say more than any other.

X309. Q. But the plant didn't work very well, did it?

A. What?

X310. Q. The plant didn't work very well?

A. It didn't turn out very well, because my orig-

inal method that this plant was to follow was not thoroughly followed.

X311. Q. What accelerator was the Republic using during that time in commercial work?

A. During what time?

X312. Q. In the first eight months of 1918.

A. Why, they were using several.

X313. Q. More thio. than anything else?

A. I can't say exactly that. They were using several.

X314. Q. Now, you recall, do you not, that Mr. Daniels went to the Philadelphia meeting of the American Chemical Society, and that on his return he talked to you about accelerators?

A. I do.

X315. Q. And at that meeting he had made notes of things said or written by Dr. Kratz, and he had that note with him?

By Mr. Kennedy:

I object to that, on the ground it is outside the cross-examination, and another obvious attempt to introduce into the plaintiff's *prima facie case* matters of defense. So far as this Kratz lecture and the visit to Philadelphia are concerned, they are absolutely outside of anything said or suggested on direct examination—no reference made to any such visit.

By the Court:

Not specifically, but here is a certain subject matter which goes to show an independent investigation, and he has told what his labors were. Now, if there is anything which tends to test his

credibility in that matter, it is a proper subject of cross-examination, I take it. I will overrule that objection and note you an exception.

By Mr. Kennedy:

I assume, then, that the examination is permitted for the purpose of attacking the credibility of the witness, and not for any other purpose?

By the Court:

Well, it is admissible for that purpose. Of course it will be determined as to whether it is admissible for any other purpose when we come to it, but it is admissible for that purpose at the present time. If you want an exception I will note it.

By Mr. Kennedy:

Oh, yes, we desire an exception.

X316. Q. Now, will you answer the question?

(Question read.)

A. Yes.

X317. Q. That information that Mr. Daniels conveyed to you included the numerical representation given by Dr. Kratz to indicate the relative accelerating values of certain substances, including D. P. G., and anilin?

By Mr. Kennedy:

The same objection, your Honor.

By the Court:

Very well. Exception noted.

A. Yes.

X318. Q. And that was immediately after Mr. Daniels's return from Philadelphia?

A. Yes.

X319. Q. Do you recall that the question of continuing you in the employment of the Republic Company arose considerably before March of 1920? Did you know about that?

A. I have no idea.

X320. Q. Never heard of that until along in February or March of 1920?

A. That was the first time I heard of it.

X321. Q. Now, when you left the Republic, or just before you left, you applied for positions at various places, as you said this morning, and among others you applied at the Firestone Rubber Company in Akron?

A. Yes.

X322. Q. And they caused you to make out their usual formal application blank?

A. Yes.

X323. Q. And you made out that blank and left it there in the regular course of applying for a job?

A. Yes.

X324. Q. At that time you were very much in need of a job?

A. Yes. I was in need of employment; I had to support my family.

X325. Q. Your funds were very low and you had a family to support?

A. Sure.

X326. Q. This paper that I hand you is the original application that you made out, isn't it?

By Mr. Kennedy:

I reserve objections to that, your Honor.

By the Court:

Well, this is merely preliminary.

A. Yes; that is in my handwriting.

X327. Q. Where did you get the information stated on here, reading as follows: After referring to D. P. G., you say: "The laboratory tests show that one part of this product is equivalent to four parts of thiocarbanilid and one and one-half parts of hexamethylenetetramine." Where did you get that information?

A. I got that from practical experience with D. P. G.

X323. Q. There are tests in the X-book that would convey that information?

A. Yes.

X329. Q. What did you expect that statement to indicate to Mr. Shepard and to Mr. Young, who you say saw this application—particularly Mr. Shepard, with whom you talked? What did you intend him to derive from this statement, for instance, that one part of D. P. G. is equivalent to four parts of thio.?

A. To show how much more active D. P. G. is, compared with thiocarbanilid.

X330. Q. And that mere statement there would suffice to show him that you considered D. P. G. more active?

A. More active.

X331. Q. More active than thio.?

A. Yes.

X332. Q. He would understand further that in your opinion he could use one-fourth part of D. P. G. instead of one of thio., or if he used the same amounts of D. P. G. and thio., he would get a quicker cure, or cure with a less temperature. Is that correct?

A. I must hear that question.

(Question read.)

A. Well, that is not entirely correct, or properly stated.

X333. Q. Well, then, please state what you wanted him to understand by that statement of yours?

A. Well, what I wanted him to understand was this: that in a compound, assuming that he used four parts of thio., he would get an optimum cure; if he used one part of D. P. G., he would get an optimum cure. That is about all.

X334. Q. Suppose he used the same amount of thio. and D. P. G.?

A. Why, then he would get entirely different results.

X335. Q. Of course he would get an over-cure at the same time, with the temperature, but he could cut down the time or the temperature, or both. That is true, isn't it?

A. Why, he would have to do experimentation, in order to adjust his compound to the particular accelerator.

X336. Q. Very true. Did you tell Mr. Shepard, with whom you talked at the time you made this application—did you tell him that you were the individual who had originated the idea of using D. P. G. as an accelerator?

A. No, sir; not in those words.

X337. Q. Did you tell him that in substance?

A. Not in those words.

X338. Q. Well, did you convey that in substance?

A. I conveyed the idea that I experimented with D. P. G. and tested it out, and embodied my idea in the application there, in a way.

X339. Q. But you haven't answered my question. I asked you if you told him that you were the one who had originated this idea, the first one to conceive the idea of using D. P. G. as an accelerator?

A. I did not tell him that in those words; no.

X340. Q. Did you tell him that in substance?

A. I thought I did; yes.

X341. Q. It isn't on that application anywhere, is it?

A. There is some idea in that.

X342. Q. Will you look there and point out any suggestion that you considered yourself to be the originator of the idea of using D. P. G. as an accelerator?

A. Well, here it is. I say, "The laboratory tests show the relative—show that one part of this product" meaning D. P. G.; and when I said, "the laboratory tests show," I meant my tests, my laboratory tests—"that one part of this product is equivalent to four parts of thiocarbanilid and one and one-half parts of hexamethylenetetramine." And then I proceeded to give the physical characteristics of this product, and also show the course of it, showing my great familiarity with this substance.

X343. Q. We are not talking about your familiarity with the substance, at that particular time.

We will concede, for the purpose of this question, that you were entirely familiar; but what I am asking you at the present time is, did you claim at that time, in the course of your talk with Mr. Shepard, that you were the individual who first suggested using D. P. G. as an accelerator? Did you do that at all, and if so, did you do it orally or show it on paper?

A. In talking to him orally, I think I conveyed part of that idea, but I am not positive as to that. I spoke a great deal about my work with D. P. G., and I understood that to be that I was the one who did all that work in the past.

X344. Q. Then you did not put it on this application, but you meant to convey to him orally that you considered yourself to be the originator of the idea. Is that the fact?

A. I didn't put it in the application in these words—in those parts that I read, I understood that they would convey to him the idea that I worked with D. P. G., and that I was the originator of it.

X345. Q. You remember we had this same matter up in the course of the National suit, don't you?

A. I don't recall all that was up there.

X346. Q. Then I will read you this question from your examination in the aniline case. We were referring to Mr. Shepard, and I asked you, in XQ. 521: "Did you tell him that you were the man who first conceived the idea of using diphenylguanidine as an accelerator?" And you said, "I did not."

A. I didn't tell him in those very words; no.

X347. Q. Do you remember Mr. Stephens, at the Republic Company?

A. Yes.

X348. Q. Did you ever tell him that you were the originator of the idea of using D. P. G.?

A. I never spoke to him about D. P. G. that I know.

X349. Q. Did you ever tell Mr. Clark that you had originated the idea?

A. I never spoke to Mr. Clark about D. P. G. that I recall.

X350. Q. But notwithstanding the statement here in the aniline record, you think you conveyed—you intended to convey to Mr. Shepard that you considered yourself to be the originator of the idea?

A. Yes.

X351. Q. Now, you then went to New York and you applied for a position with the National Aniline Company, and there again, in the course of that application, you mentioned Dr. Kratz as one who had worked on D. P. G. That is true, isn't it?

A. Yes.

X352. Q. Did you claim in the course of your application for a position there, that you were the originator of the idea of using D. P. G. as an accelerator?

A. I don't think I did.

X353. Q. I hand you the paper that was used as an exhibit in the National case, this being an exact reproduction of the original application for employment with the National Company, made out by you. You recognize that, do you not, as a copy of the application you made?

A. Yes; this appears to be a copy of it.

By Mr. Edmonds:

I ask that the paper just referred to be marked for identification Defendant's Exhibit "B." And I also ask that the Firestone application, to which the witness referred, be marked for identification as Defendant's Exhibit "C."

X354. Q. Then you went to Messrs. Doty and Woodward and applied for employment there, and you took with you a small amount of this powder, that you left with them, when they showed some interest, for such use as they might want to make of it, understanding that they were going to make a test of it?

A. I didn't apply for employment there.

X355. Q. Well, what was it that took you there?

A. I wanted to interest them in the manufacture of this material and have them introduce it into the rubber trade.

X356. Q. You knew of them as selling antimony, the thing that you had worked with, and you were there at that time because of that, and this talk of rubber accelerators came up in the course of the talk that started with antimony?

A. I mentioned antimony, too.

X357. Q. Then in the course of time you found they were interested in rubber accelerators, and you left with them this sample of D. P. G. that you had with you?

A. I knew they were interested in rubber accelerators, because we got a sample of their rubber accelerators at one time, which test I made and recorded in the X-book.

X358. Q. And you left a sample of D. P. G. with them?

A. Oh, yes.

X359. Q. And you understood they were going to make a test of it?

A. I gave them the formula to make a test.

X360. Q. And you did not tell them what the substance was?

A. I did not. I told them it was a new accelerator that I had.

X361. Q. And then a few days later you came back and had a further discussion with them, and that led to the signing of a contract?

A. That is right.

X362. Q. At that first talk, before you told them what the accelerator was, that is, what its chemical name or formula was, what did you tell them about it?

A. I told them that I had a new accelerator that was very active, and that it was one and one-half times as active as hexa. and four times as active as thio., and produces very good results with rubber, gives a high tensile, cuts down the steam pressure or temperature with which a compound is cured, and also the time; and I offered a sample, that they should test it out, in comparison with any of those mentioned, and find out for themselves what it is.

X363. Q. When you told them it was so many times as active as hexa. and thio., what did you expect them to understand by that?

A. Why, I expected them to understand that that is a superior accelerator.

X364. Q. In what respect?

A. In the respect that it produces good results at a lower temperature and shorter time, and it re-

quires less work than others to produce the same results, or similar results.

X365. Q. That is what one would naturally understand from seeing that it is four times as active as so-and-so?

A. With respect to certain characteristics only—by cutting down the time or temperature. It does not necessarily apply to all the qualities that rubber would possess, by the use of this accelerator.

X366. Q. Then at this second meeting, or some meeting, you told them what the substance was?

A. I did.

X367. Q. Was that before or after you had arrived at an agreement under which they were to co-operate with you in exploiting this accelerator?

A. I believe it was during that time the agreement was written up and at the time it was signed.

X367. Q. I didn't ask you that. I asked you when you told them what the accelerator was?

A. At that time.

X369. Q. At what time?

A. That the agreement was written up and signed.

X370. Q. Now, was it before the agreement was signed or afterwards?

A. During the time—that is, the same day, or the same session we had.

X371. Q. Well, the purpose, I take it, of not telling them at the first meeting was that you did not propose to tell them until you knew whether you were going to reach an agreement to exploit it?

A. That is correct.

X372. Q. Now, did you reach an agreement and

sign up a contract before you told them, or did you decide to tell them before any agreement was actually signed?

A. At the time the agreement was reached, I told them what it was.

X373. Q. Before it was signed or after it was signed?

A. After it was signed.

X374. Q. Now, that is just what you said in the National case, isn't it? For instance, in XQ. 541, I said: "And did you tell them what this accelerator was before that was signed or afterwards?" And you said, "After that was signed."

A. I believe that was the case, as I recollect it. I don't remember it exactly. I took Messrs. Doty and Woodward for gentlemen at the time we reached the agreement, and understood it was perfectly well to tell them that, and if I recollect it correctly, I told them that after we signed—just after we signed the agreement.

X375. Q. You had a purpose in not telling them what the accelerator was at first?

A. Until we reached the agreement; yes.

X376. Q. Yes. And that purpose led you to withhold telling them what the accelerator was until after the agreement was signed. Is that correct?

A. That is correct.

X377. Q. What?

A. The purpose was—Yes, until an agreement was reached. That was mainly the purpose; it wasn't a question just of signing it.

X378. Q. That is the question I am asking you, and you at once said you did not tell them what it was

until after the agreement was signed. Is that your testimony?

A. If I recall it correctly, that was the case. Whether I told them that just before it was signed or just after it was signed, I don't recall; but I do recall exactly that I told them that after an agreement was reached.

X379. Q. On reference to this book (handing volume to witness), you see, do you not, that you testified in the aniline case that the disclosure as to what this accelerator was did not take place until after the contract was signed?

A. Yes; that is the testimony that I gave then.

X380. Q. Now, after you gave them this sample of D. P. G., without telling them what it was, several days elapsed—a few days elapsed—before you returned, and they told you that they had tested the accelerator and were interested in it? That is true?

A. Yes.

X381. Q. You certainly did not tell them what the accelerator was on that first occasion. You are very sure of that?

A. Oh, yes.

X382. Q. But that is not consistent, is it, with the statement that you made in one of the affidavits that you filed in the Patent Office when you were soliciting this patent? This was at the time you were endeavoring to carry your date of invention back of some reference cited as a basis for rejection. You say in this affidavit—page 650 of the record—you say in this affidavit: "On or about the 7th day of April, 1920, I called at the office of Mr. Henry F. Doty, and Mr. Van Lear Woodward, 30 Church Street, New York

City, and disclosed to them the said invention, and also delivered to them at said time and place a sample of diphenylguanidine." Can you explain that apparent inconsistency?

A. That is not the first time I called at their office. There is no mention in this affidavit that it was the first time or the second time.

X383. Q. No, there is not. Is that the only explanation you have to give?

A. That is the explanation.

X384. Q. Nothing more to say?

A. No.

X385. Q. You note that the affidavit says you made this disclosure at the same time that you called and left the sample?

A. I left a sample then. I had a sample with me when we reached an agreement. I gave them some more.

X386. Q. That is the best answer you can give?

A. That is the best answer I can give.

X387. Q. Now, this man Stephens that we referred to a while ago told you that accelerators were not patentable at one time, did he not?

A. He did.

X388. Q. But you found out early in 1920 that they were patentable?

A. Not early in 1920.

X389. Q. In the spring of 1920, when you went to New York and went to the Library there and took occasion to look up the subject?

A. It was toward the end of the spring; in the summer.

X390. Q. And you found there had been accelerator patents issued?

A. I found there had been accelerator patents issued; yes.

X391. Q. But no application for patent was filed by you until July, 1921, when you filed an application for a patent on a process for making D. P. G. That is correct?

A. That is correct.

X392. Q. And in August of 1921, I believe it was, you filed an application for patent on an accelerator which we call D. O. T. G.—that is right?

A. Yes.

X393. Q. You don't know why the application for the patent in suit was deferred until the following November?

A. No; it was out of my jurisdiction. My business associates had to do with that.

X394. Q. Now, I understand you to say that the tests recorded on this page X-2006, in the Two Thousand X-Book, although they were undated, were made at some time prior to the tests on the preceding page, all of which are dated, and some time prior to the tests on the page preceding that, most of which are dated, and prior to the tests on the page preceding that, all of which are dated, and so forth. That is correct?

A. That is correct.

X395. Q. In fact, you say that they were made prior to September, 1919?

A. Yes.

X396. Q. Of course, there is no connection in your mind between that and the Kratz paper?

A. No.

X397. Q. Now, at three other places in this book there are tests which include D. P. G., and which are dated prior to September, 1919, if we include within the three the one whose date has been changed. That is right, is it not?

A. Yes.

X398. Q. You recall, do you not, that during the trial of the National suit, you were asked to state what tests in this book, using D. P. G., were made prior to September, 1919?

A. I don't recall exactly just what I was asked.

X399. Q. You do recall, do you not, that never in the course of the trial of the National suit was there any suggestion that any of the tests recorded on page 2006 were made prior to September of 1919?

A. There was something said about it, if I remember right. I didn't see the record—

X400. Q. Then I will ask you to let me recall something to your mind from the National case. At one time during the trial of the National case—this is page 281, XQ. 430—while you were under cross-examination, and shortly before a noon recess, the following questions were put to you: "XQ. 428. Excepting this entry on page 2034, that we have just been referring to, and also the entry on page 2006, dated February 21, 1919, and also the entry on page 2042, of March 4, 1919, can you point to any entry in this book, showing the use of diphenylguanidine at any time prior to the 10th day of September, 1919?" And you said, "Used by us, you mean?" And I said, "Yes, or anyone else." You said, "I will have to start from the beginning." And then I said to you, "I will

ask you to do that during the noon recess, and if you can find any entry of that sort, I wish you would call my attention to it. My own opinion is that you will find none, but if you do not accept that statement, I want you to tell me." Now, do you recall that that occurred?

A. Yes; it is in the record here.

X401. Q. And you never made any statement to me from that time on that any other test recorded in this book was a test made prior to September, 1919?

A. As I recollect, I don't believe I did say anything like that.

X402. Q. Well, let us take it step by step. Did you ever, in response to that, state to me that any other test was made prior to September, 1919?

A. I didn't tell you anything after that, if I recall it right. I don't believe you asked me after that again.

X403. Q. I asked you right in that question. Did you ever respond to that in any way?

A. No; not to that question.

X404. Q. These two tests on shoddy compounds with D. P. G., to which you have referred, they indicate no superiority for the D. P. G. over T. P. G. in that compound, do they?

A. May I refer to that?

X405. Q. Oh, yes—One is on page 2006, column H—

A. I have got it.

X406. Q. And the other is on 2042, column A?

A. The tests on 2006-H show a distinct superiority over T. P. G., as shown in the X-book, because that comparison was made, and the comparison is recorded

on X-2005-G, in which experiment three parts of T. P. G. were used as compared with two parts of D. P. G., used in experiment X-2006-H. This experiment in X-2005-G shows that a compound was cured for twenty minutes at 35 pounds steam pressure, and had a stretch of 11 inches, and a tensile strength of 525 pounds, and a set of 19/32. Done at the same time as the experiment recorded in X 2006-H. It is in my handwriting, and is dated 2/21/19, exactly as the experiment recorded on 2006-H, which is dated 2/21/19. It shows a distinct advantage by having a tensile strength nearly 200 pounds greater than the compound in which three parts of T. P. G. was used; also, it was cured in a shorter time, and had a lower steam pressure or temperature.

X407. Q. The statement that you have just given is contrary, if I remember right, to the testimony you gave in the Aniline case, or in the National case. Don't you recall that you said at that time that the two experiments with shoddy compounds show no advantage of D. P. G. over T. P. G.?

A. I don't recall, but I do recall that was the first time I saw that X-book ever since I left the Republic Rubber Company, and under cross-examination at that time I didn't analyze the two compounds I prepared.

X408. Q. You were particularly interested in shoddies back there in January and February, 1919, weren't you?

A. Before that, too.

X409. Q. And when you made some D. P. G. your first thought was to try it in a shoddy compound?

A. I did that with all accelerators that I tested.

X410. Q. And that was the first thing you did with D. P. G. in 1919?

A. No. The first thing I did with any accelerator, as I did with D. P. G., was to test it out in a rubber accelerator testing vessel.

X411. Q. In the National case, I asked you about these experiments with shoddy, and you said, "That is reclaimed rubber, and I know that the accelerators in use at that time, hexamethylenetetramine and thiocarbanilid, were not satisfactory, and I tried previous to that, in 1918, when I worked on hydrolene and T. P. G. in a shoddy compound, and found it was satisfactory to a degree. My first thought then, after I prepared D. P. G. in a quantity that I could test out, was to see how it would work on a shoddy compound, and I prepared a shoddy compound and tested that out, and found from the results, though, that it was not to any degree much better than T. P. G. It was a little better than T. P. G." Do you wish to change that now?

A. I said it was better. It was largely a question of degree, and at the time I answered that, I didn't recall the exact figures I got with T. P. G. But these figures are here, and were here, and the tests were made, and I made the tests; only after a lapse of time, I didn't have the exact figures at my finger-tips, but I knew it was better.

X412. Q. So you still stand by this answer, "It was not to any degree much better than T. P. G."

A. I said also it was better.

X413. Q. "It was a little better than T. P. G."?

A. It was better to a larger degree—now, when I compare the figures.

X414. Q. So you want to change that now to mean it was much better?

A. It shows that distinctly.

X415. Q. Well, two people might disagree as to what those figures show, so I am asking you if you still stand by the answer you gave before, or if you want to make a different answer?

A. This is my opinion, that it stands out much better than the tests made with T. P. G. under those conditions at that time.

X416. Q. And this answer gives your opinion at the time of the National trial?

A. I said it was better, and it was only a question of degree, and I didn't specify that degree to any large extent. I said it was a little better than T. P. G.

X417. Q. Now, please look at page 2005 of this X-book. At the top of this page appears the words "On shoddies." Do you recognize that as having been written there by you?

A Yes.

X418. Q. Over here on the left-hand side is "D shoddy," and "Z shoddy," and "C shoddy." Were those three written there by you?

A. Yes.

X419. Q. Under that appears the name of some chemical, written in longhand. Is that yours?

A. Yes.

X420. Q. And under that seems to be "Triphenylguanidine." Is that yours?

A. Yes.

X421. Q. Under that is "Brown crepe," or a provision for it. Is that yours?

A. Yes.

X422. Q. Down below, "Barytes," and under that appears the name of some chemical written out in longhand. Are those two your writing?

A. Yes.

X423. Q. Now, look at the figures in the columns headed by the printed letters A, B, C, D, E, F, G, and H. Are the figures in those particular columns yours?

A. Yes.

X424. Q. Down at the bottom of column G, or below the bottom of that column, seems to be written "Was not cured well." Is that your writing?

A. No; it isn't "Was not cured well."—"Was not mixed well."

X425. Q. Excuse me. "Was not mixed well."—Is that your writing?

A. Yes.

X426. Q. And under the last column at the right is another written statement. Is that your writing, and if so, what is it?

A. It is my writing.

X427. Q. And what does it say?

A. "Not mixed well."

X428. Q. These columns from A to H, inclusive, have dates at the bottom of them which I understand you to say were written there by you, and from those dates you are able to say you made those tests on or about those dates and entered them in the X-book on or about those dates?

A. Yes.

X429. Q. This statement at the top of the page, "Action of organic Accel." That wasn't put there by you?

A. No.

X430. Q. And over here at the left appears "Diphenylguanidine," and that was not put there by you?

A. It was not there at the time I used that page.

X431 Q. That was not what I asked you. I asked you if you put it there?

A. No; I didn't put it there.

X432 Q. Now, these figures in the column that has no letter at the top, the column at the left of column A, those figures were not put there by you?

A. No; I didn't put those figures there.

By Mr. Edmonds:

May I have the answer that the witness volunteered stricken out, please? The witness volunteered that something was not there, which was not the question asked him at all. I asked him if he wrote that there. I don't mind it standing, except that I don't want it standing as testimony brought out by the defendant. So I ask that that volunteered answer be stricken out.

By the Court:

If there is no objection, that will be done.

X433. Q. Just to clear up the matter—I asked you if you wrote this matter in parenthesis at the top of the first column of figures, which seems to be "X 2004-C"; I don't know what it means, but I will ask you if you wrote it there?

A. No.

X434. Q. Now, I understand that you claim that you devised an accelerator called ditolylguanidine, and that you disclosed that to Mr. Daniels, and that you made some of that in 1920, I believe, and that you call a disubstituted guanidine. Is that correct?

By Mr. Wooster:

That question is strictly outside of the direct examination, if it is not to be an inquiry into dates of invention—

By Mr. Edmonds:

I have no interest in the dates. I thought they were public now.

X435. Q. Will you answer, please?

A. Yes.

X436. Q. You made no particular disubstituted guanidine between the time of making D. P. G. and ditolylguanidine?

A. I didn't actually any.

X437. Q. Now, what was the next disubstituted guanidine that you made after making ditolyl?

A. I made phenyltolylguanidine.

X438. Q. Is that a disubstituted guanidine?

A. Yes, sir.

X439. Q. When did you make that?

By Mr. Wooster:

Objected to, as outside the direct, and involving dates of specific inventions not involved here.

By the Court:

The particular purpose is in connection with these number of claims of the patent which they

assert cover all disubstituted guanidines, including his ditolyl, and I suppose they would say these ditolylphenyltolylguanidines—or whatever it is—and I wish to know how far this witness is qualified to say whether or not all disubstituted guanidines were accelerators. That is a very pertinent inquiry, because they are presenting and insisting on claims which they call class claims, claims covering a whole class of substances, instead of just one substance, diphenylguanidine.

By the Court:

Go ahead. We will allow you to ask the question.

By Mr. Wooster:

Will your Honor specifically rule whether he should give dates of when he made these later compounds?

By Mr. Edmonds:

I will amend the question. Perhaps you will not object to it in a different form.

X440. Q. Will you state whether or not you made this phenyltolylguanidine prior to November of 1921?

A. I did not make it prior to November of 1921.

X441. Q. Then prior to November, 1921, the disubstituted guanidines with which you were familiar —with which you had become familiar by actual test, were D. P. G. and ditolyl?

A. As specific matters of this class; yes.

X442. Q. Those are the only ones—that is what

I am asking you? Were those the only ones that you knew by test to be accelerators up to November, 1921?

A. By test; yes.

X443. Q. Those were the only ones. Now, will you state whether or not dianisylguanidine is an accelerator?

By Mr. Wooster:

We object to that as outside the direct examination, and as hypothetical.

By the Court:

It might in some way throw light upon the knowledge—or test the knowledge—of this particular witness, and throw light upon his testimony, in so far as it affects his claim of invention of this particular matter that is here in suit. We will allow it.

Exception noted to plaintiff.

A. Yes, it will be; to a degree.

X444. Q. That is a disubstituted guanidine, isn't it?

A. Yes, that is a disubstituted guanidine, only I would like to refer to a specific formula, as I understand it is made from anisal.

X445. Q. I now hand you a formula of dianisylguanidine. Now, will you answer the question?

A Yes, this is a disubstituted guanidine, and in my opinion it will be an accelerator to a degree.

X446. Q. Will you undertake to say whether or not any substance which is a disubstituted guanidine, and of which you know only the formula—whether or not that is an accelerator?

A. Yes, I can say to a degree.

X447. Q. Now, let us not qualify everything by saying "to a degree." Can you say whether or not a substance is an accelerator, if I give you the name of it?

A. No; I can't say that.

X448. Q. Can you say definitely whether or not this substance is an accelerator—and I understand you have not tried this—this dianislylguanidine, can you say definitely whether or not that is an accelerator?

A. From its structure—Of course I don't know if it exists as such; I am not familiar with this particular guanidine—but from its structure I would say it is an accelerator to a degree. I don't know whether it is existing in its free state, or in what condition it does exist, but just judging from this formula, and being familiar with this class of disubstituted guanidines, I would say it would be an accelerator to a degree.

X449. Q. Do you know how many disubstituted guanidines there are, or can you give us a fair estimate of that?

A. No, sir.

X450. Q. Would you say a dozen or a hundred, or a thousand, or what?

A. I can't give you any estimate. It would be purely a speculation.

X451. Q. You don't know whether a dozen or a thousand is nearer?

A. It would be a dozen—more than a dozen, maybe.

X452. Q. But you don't know whether a dozen

or a thousand—which of those two is nearer the right number?

A. Oh, a dozen is more the right number. It may be more than a dozen disubstituted guanidines would be accelerators—more than a dozen. I haven't counted them.

X453. Q. I show you the formula for another disubstituted guanidine. Would that be an accelerator of rubber—I show you the formula of dibenzoylguanidine?

By Mr. Wooster:

Objected to as hypothetical and outside the direct examination. A chemist can write down innumerable formulas of substituted guanidines, and cross-examining counsel can come in here and call them such and give a name to them, but that is not an issue in this case. The defendant is here, because it uses a specific disubstituted guanidine, which is called diphenylguanidine. I think the line of examination is a matter of defense, rather than to test the memory or the qualifications of this witness, in view of what he testified on direct examination.

By Mr. Edmonds:

The difficulty is not with the defendant. It is that the plaintiff is here asserting that this is a patent which covers all disubstituted guanidines.

By the Court:

You are relying upon your fifth claim, aren't you?

By Mr. Wooster:

Yes.

By Mr. Kennedy:

May I say a word? If they have anything in the prior art that is admissible here, then these things that they have reference to may, at least, for the purposes of argument, be relevant and material to the case, and possibly also on the cross-examination of this witness. But so far as we know, they are purely hypothetical things, with which the issues here are not concerned. The issues here are concerned, so far as the validity of the claims are concerned, with the defenses that they have set up, and what the defendant is using. The defendant is using not only a disubstituted guanidine, but a specific form of disubstituted guanidine, namely, diphenylguanidine. Now, as to whether or not these things are disubstituted guanidines is entirely irrelevant and immaterial, and certainly outside the direct examination of this witness, and therefore improper cross. Theoretically, if this is permissible, they can go through a whole list of their own, or books, or anything else, and ask these identical questions, and then prolong a case that they say they are desirous of accelerating.

By the Court:

We agree with what counsel has said, to some extent—that perhaps it does not tend to shed a very great deal of light on the case, but at the same time is something which may test the witness, in so far as his claims of invention are con-

cerned, and his claims as to his investigations. It might throw some possible light on it. Whether it is worth the time that is being taken up on that line, I seriously question, however.

(Question read at request of counsel for defendant.)

A. I don't know.

X454. Q. Is that a disubstituted guanidine?

A. From its structure it appears to be—from its structure.

X455. Q. How would you proceed to find out whether that is an accelerator?

A. By testing it.

X456. Q. As a matter of fact, that is the only way you could find out, isn't it—test it in a rubber slab?

A. We can in another way—by analogies.

X457. Q. You recognize the document I hand you, do you not, as a brief prepared in your behalf in an interference pending in the Patent Office?

A. That is what it states here. I don't remember what it complains of.

X458. Q. In this brief, on page 5, it states: "It is admitted in the testimony of all the parties to this record that one cannot foretell whether or not a given compound will be an accelerator of rubber." That is stated in this brief filed in your behalf in Washington. Is that a correct statement?

A. I didn't write that.

X459. Q. What?

A. I didn't write that.

X460. Q. But I am asking you whether that is

a correct statement. Do you dispute that statement, or is it correct?

A. I dispute that in a way.

X461. Q. In a way? That leaves us very much in doubt.

By Mr. Edmonds:

May I have this brief marked for identification, and I wish to offer this in evidence on behalf of the defendant at the proper time, if that may be done. I think it will shorten the examination quite considerably.

By the Court:

You may mark it at this time, and we will consider the admissibility of it when it is offered.

(The brief was thereupon marked for identification Defendant's Exhibit "D.")

By Mr. Edmonds:

We can shorten this examination somewhat by a concession, if counsel for the plaintiff wish to do so. I will make a statement of what we will concede, and see if that is agreeable to counsel for plaintiff.

The application for patent filed by Mr. Weiss —for ditolylguanidine, filed, as he stated, in August, 1921—has become involved in an interference proceeding in the Patent Office, and that the issue in that interference concerns both this accelerator ditolylguanidine and a broader claim of all orthotolyl guanidines as accelerators, and in that proceeding Weiss is contending that the broad claims on orthotolylguanidines are not

patentable claims at all, and that should be withdrawn, and the proceeding go on only as to the narrower claims of orthotolylguanidines, and this brief that I have just questioned Mr. Weiss about is the brief filed in his behalf in that interference, where this contention is advanced with respect to this broad claim, and where priority on behalf of Weiss is argued as to the less broad claim on ditolylguanidine. That is a statement of fact, isn't it, Mr. Wooster?

By Mr. Wooster:

I am not prepared to concede that now, but there is no objection by the plaintiff here, to the entire record and briefs in that interference being considered here, in so far as the points may speak for themselves. In other words, there will be no question by plaintiff here that those are the records, and Mr. Edmonds can argue anything he wants from them. I cannot, without going over a thousand pages of printed record and two hundred or more of printed briefs, make any stipulation such as he states here.

By Mr. Edmonds:

This is just a statement of the broadest features of the proceeding, and there could not be any mistake as to them. Of course, if you would like to see that written out, and then examine it more closely, we can hold that over until you have seen it in type.

By the Court:

That is a suggestion, which counsel for the other side, of course, are not called upon to agree, unless they desire to do so.

By Mr. Edmonds:

X462. Q. This ditolyl application of yours is owned by the plaintiff, the Dovan Chemical Company?

A. Yes.

RE-DIRECT EXAMINATION.

By Mr. Wooster:

463. Q. In your direct examination, did you say that you mentioned to Mr. Holliday that you were using diphenylguanidine as a rubber accelerator?

A. Diphenyl.

464. Q. Diphenylguanidine?

A. No; not diphenylguanidine; I called it diphenyl.

465. Q. Did you at any time tell Mr. Holliday what the full name was?

A. No.

466. Q. Relative to your disclosures of diphenylguanidine, to Mr. Carlton, Mr. Daniels and Mr. Nellen, where did your disclosure of diphenyl to Mr. Holliday come in?

A. Well, about that time that I got the optimum cure of diphenylguanidine, and that was about February of 1919, or the latter part of January, when I made those cures, I also made some tests with triphenyl guanidine, and Mr. Holliday noticed the shortness of the cures, and he asked me, saying, "You have something good here." I said, "Yes, that is diphenyl."

And that is all I meant to say to him. I didn't want to convey to him the whole idea of what it was at that time, but just so as to differentiate between the other, the other being made with triphenylguanidine, the cures of which were high.

467. Q. Was that before or after you had mentioned D. P. G. to Mr. Nellen?

A. That was before.

468. Q. Was it before or after you mentioned D. P. G. to Mr. Daniels?

A. That was after.

469. Q. Do you recall the names of any of the accelerators that were used in the first eight months of 1919, in the regular product of Republic Rubber Company?

A. Yes; hexamethylenetetramine and thiocarbanilid. Those were the ones that were used.

470. Q. Did they have code names?

A. Yes.

471. Q. What were they?

A. "Mexa" was for hexamethylenetetramine, and "Cromite" was the one for thio.

472. Q. Anything else?

A. There was another accelerator used to a small extent, and the code name for that was, "Flasco."

473. Q. What was its active ingredients?

A. Paranitrosodiemethylanilin.

474. Q. After you applied to National Aniline & Chemical Company for a position, to whom did you apply?

A. I applied in the office, and I was referred to a man by the name of—

475. Q. Wait a minute. To what company did you next apply? After you applied to National Aniline & Chemical Company, to what company did you next apply?

A. Roessler & Haslacher Chemical Company.

476. Q. Where?

A. At their office in New York City.

477. Q. Whom did you see?

A. The clerk advised me to write a letter to their Dr. Carveth, who was at the Perth Amboy plant.

478. Q. Did you do it?

A. Yes.

479. Q. Did you afterwards have an interview?

A. Yes.

480. Q. Where?

A. At the Perth Amboy plant.

481. Q. With whom?

A. Mr. Dill and several other people who were with him.

482. Q. Did they give you a position?

A. No.

483. Q. What did you say to them?

A. I told them that I had a good accelerator, and I know how to make it, and wanted to make it. and they asked me details about it, and that is as far as it went.

484. Q. You didn't tell them what it was?

A. No.

485. Q. Was it before or after you had seen Mr. Dill that you saw Messrs. Doty and Woodward?

A. It was after I saw Mr. Dill that I saw Messrs. Doty and Woodward for the first time, when I got an

answer to my application and made an appointment with Mr. Dill and went up to see him.

486. Q. Was it before you made the contract with Doty and Woodward?

A. Yes.

487. Q. I show you a contract purporting to be between yourself, Van Lear Woodward and H. S. Doty, dated April 13, 1920, and ask you to look at it and state what it is?

A. This is the agreement, the memorandum of agreement, that I entered with Messrs. Doty and Woodward. This is the agreement.

488. Q. Does this contract enable you to state whether or not you had disclosed diphenylguanidine to Messrs. Doty and Woodward before or after you signed this contract?

A. Why, before—that was on account it was written up before I actually signed it.

489. Q. Do you recognize the signatures on this contract, and if so, state whose they are?

A. Yes. There is my signature on it, and one of Van Lear Woodward and H. S. Doty, that I recognize.

By Mr. Wooster:

It is stipulated that a correct abstract of this contract is printed at pages 71, 72 and 73 of the Record for Weiss, in Patent Office Interferences 47394 and 49357, and that said abstract may be referred to in this case in lieu of the original here produced.—To avoid reference to the printed record, I will offer a typewritten copy of this abstract as Plaintiff's Exhibit 4.

490. Q. Did Mr. Daniels, upon his return from Philadelphia, tell you that Mr. Kratz had compared thio. and hexa. with D. P. G.?

A. No, sir.

By Mr. Edmonds:

I object to the question. You shouldn't lead the witness that way. Ask him what he told him, or something of that sort. The answer is all in the question.

By the Court:

Yes; it is perhaps leading. I don't recollect the testimony that was given, to which that is responsive, however. What was the testimony? Was that on cross-examination?

By Mr. Wooster:

It was cross-examination about what Mr. Daniels told Mr. Weiss as to what Mr. Kratz had said at Philadelphia. That was brought in over objection.

By the Court:

Well, the inquiry is in and answered, and I will not strike it out; but it is not in very desirable form of introduction.

By Mr. Wooster:

May I withdraw it and start again?

By the Court:

Well, now that it is in, I believe we had better leave it in. It will simply add to the time.

491. Q. You were referred to an apparent change in the date of test 2034-E, wherein the only figure appearing to be changed is the first figure "2"? Do you know anything about that change?

A. Why, I probably made that change from a "1" to a "2," as February was so close to January, I might have put down "1/10/20" and corrected myself, making a "2" out of the "1," which is apparent.

By Mr. Edmonds:

I ask that that answer be stricken out. I don't think that speculation from a witness should be permitted in this record.

By the Court:

I shall allow it to stand. Of course the weight of it will be for consideration by the Court.

492. Q. Referring now to X-book, page 2005, you said in cross-examination that the ink-printed words in the first column, "diphenyl guanidine" were not written by you. When did you first see those words on that page?

A. At the trial of the National and the Dovan, when I saw the X-book for the first time after I left the Republic.

493. Q. Could you say whose handwriting that is in?

A. No.

494. Q. When you first saw this page X-2005, in the X-book, what was written on it?

A. This caption here, "Action of organic accel." I remember this being written on (indicating), and these figures here (indicating), and this "X-2004"—

495. Q. Now, you say "these figures"—The Ink figures?

A. 2005, and in parentheses, "X-2004-C."

496. Q. What was the next writing put on this sheet?

A. The next writing I put down, "D shoddy," when I made these experiments—experiments recorded in 2005, column A and column B, and column C, down to column H.

497. Q. I note that parts of columns A, B, C, D, E, F, G, and H all add up to 100. In whose handwriting are these additions, "100"?

A. These are in my handwriting.

498. Q. In the column to the left of column A, the parts add up to "—101.00." Are those in your handwriting?

A. No, sir.

499. Q. At the time you last wrote on this page X-2005, what is your recollection as to whether or not the figures in the column to the left of column A, and the addition footing up to 101.00 were there?

A. It is my recollection that they were not there. I don't recall exactly whether they were there. It is my recollection that they were not there. There were no figures there.

500. Q. What is your recollection as to the ink-printed "diphenyl guanidine"?

A. It is my recollection that that was not there.

501. Q. What is your recollection as to the date at the bottom of column to the left of column A, "2/22/17"?

A. I don't recollect seeing that there.

502. Q. Taking the items in the column to the

left of column A as "Smoked sheets 50, sulphur 3, zinc 47," state whether or not you recognize those?

A. I don't recollect seeing those there.

503. Q. Do you recognize that as any formula?

A. Yes; it looks like a formula. It looks like a standard formula—like a standard comparison formula.

504. Q. With or without accelerator?

A. Without accelerator. It adds up to 100.

505. Q. If an accelerator is then added, do you add that on to 100 parts or not?

A. No. The accelerator is generally substituted either in the zinc or in the rubber.

506. Q. Can you point out some examples of that in the X-book?

A. Yes. This one, X-2010, column O. The accelerator was substituted in the zinc, and it adds all up to 100.

By Mr. Edmonds:

507. Q. There are various of them that add up to 101, aren't there?

A. This is an exact formula there (indicating sheet marked 2010).

508. Q. X-2035, the first column adds up to 102, also X-2028? What was your answer?

A. I answered that this 2010, column O, in which the accelerator was substituted in the zinc, instead of just being added to the standard formula, and it adds up to 100 in this formula.

By Mr. Wooster:

509. Q. I understood you to say on cross-examination that you disagreed in a way with the statement quoted from page 5 of the brief on your behalf in the D. O. T. G. interferences, to the effect that "One cannot foretell whether or not a given compound will be an accelerator of rubber." Will you explain what you meant by "in a way"?

A. Well, if that compound would be a disubstituted guanidine, derived from primary analytical (?) means, I could foretell in a way that it would be an accelerator.

510. Q. In the two formulas shown you in cross-examination, did you the carbonide group substituted in the two formulas?

A. Yes.

511. Q. Is that the same kind or a different kind of substitution as shown by you in your patent in suit of diphenylguanidine?

A. It is a different kind of substitution.

512. Q. Would or would not such different kind of substitution change the function and operation of the resulting compound, if a compound such as given by these two formulas was obtained?

A. Sure.

513. Q. As compared with a disubstituted guanidine of the type of D. P. G.?

A. It would; yes.

RE-CROSS EXAMINATION.

By Mr. Edmonds:

X514. Q. Will you turn to page X-2005 of the X-book? What was in the space directly above "D shoddy"—What was in the space there at the left, directly above where you have written "D shoddy"? You say you don't remember "diphenyl guanidine" being there. Do you remember what was there?

A. Well, just what part of the page are you referring to?

X515. Q. In the column on the left?

A. In the column on the left.

X516. Q. Yes. You don't remember what was there?

A. No. That wasn't there.

X517. Q. I am asking you what was there?

A. There wasn't anything there, as I recollect.

X518. Q. You can't recollect what was there?

A. There wasn't anything there.

X519. Q. Now, I want to get at that very definitely. I want you to say if you don't recollect what was there, or that you know that nothing was there. Which is it?

A. I recollect there was nothing there.

X520. Q. That is your recollection?

A. That is my recollection.

X521. Q. What do you recollect was in that first column?

A. I don't recollect exactly what was in there. It might have been blank, too. I don't recollect that.

X522. Q. You don't recollect anything about it?

A. No.

By Mr. Wooster:

What time are you talking about?

X523. Q. I am asking you now about your recollection about what was there when you were using this book, at the time you were in the employ of the Republic Company—there was some six years ago, five and a half or six years ago. You undertook to say that you do not recollect that "Diphenyl guanidine" was printed in that first column, I understand?

A. No. I recollect that there wasn't anything there in that left-hand column above "D shoddy"; at the time I wrote it, there wasn't anything there. It was "diphenylguanidine"; it was written that way—

X524. Q. It was written there—what?

A. There was nothing there.

By the Court:

525. Q. You mean by that, then, that this "D shoddy" and "C shoddy," and so forth, was not written there, either?

A. Oh, yes; this was written. I wrote this. I meant this legend here (indicating).

By Mr. Edmonds:

He says he wrote those, but he can't recollect what was above them.

By Mr. Wooster:

He stated there was nothing.

By Mr. Edmonds:

X526. Q. You stated your recollection to be there was nothing there?

A. There was nothing there.

X527. Q. You can't recollect whether or not there was anything in the first column for figures, but the figures that are there may have been there?

A. I don't recollect seeing those figures there. It may have been blank.

X528. Q. It may have been blank, or those figures may have been there. You don't recollect those?

A. I don't recollect those. I don't recall particularly this—I don't recall those figures in column "O," that has this caption above, in parentheses, "X 2004 C."

X529. Q. I am trying to get at just what your testimony is. You don't recall what was in that first column? The figures that are there now may have been there, or it may have been blank, so far as your recollection goes?

A. Yes; it might have been blank. I don't recall.

X530. Q. And the space immediately above, "D shoddy," you say did not have that "Diphenyl guanidine" in it? It might have been blank, or it might have had something else in there?

A. No; it didn't have anything else in there. There was nothing there written—nothing written there as I recollect, when I wrote those in the column on the left hand as they appear now.

X531. Q. Now, one further point I want to ask you about is what Mr. Daniels told you when he came back from Philadelphia, at that meeting where Dr. Kratz read his paper. What was it he told you, and if he gave you a note of anything, what was that?

A. He told me that he just came back from the meeting of the American Chemical Society, and heard

a paper read by one Kratz, who mentioned D. P. G., and he had a piece of note-paper, on which he had a table of comparison—purporting to be a comparison—on which was anilinguanidine, and diphenylguanidine and triphenylguanidine, and some figures corresponding to the names of these chemicals.

X532. Q. Figures representing their relative activities?

A. Yes, supposed to be their relative amounts.

X533. Q. Expressing their relative activities?

A. Relative amounts. One part, I recalled, of anilin, and the rest of them were fractions of one part.

X534. Q. Expressing the relative activities of those accelerators in just the way that you expressed it in your application for employment at Firestone?

A. Relative parts.

X535. Q. The answer is yes?

A. Relative parts, yes.

Adjourned until tomorrow morning at 10 o'clock.

Friday, October 9, 1925.

MORNING SESSION.

By Mr. Wooster:

I overlooked yesterday offering another exhibit for plaintiff, in the testimony of Mr. Weiss, and will recall him for this purpose.

MORRIS L. WEISS, recalled, testified as follows:

DIRECT EXAMINATION

By Mr. Wooster:

536. Q. You said yesterday that Mr. Nellen gave you the formula of a factory compound. Is that right?

A. Yes.

537. Q. Was this given orally or otherwise?

A. A written formula.

538. Q. Have you that written formula?

A. I have.

539. Q. Can you produce it?

A. Yes. This is the formula of a compound that had a code name, and the code name is written on it, which is "MYE," which Mr. Nellon informed me was a packer compound. This is put down on the righthand upper part of the sheet of paper, on which this formula is written, and is also put down opposite the line which reads, "Chromite, 4 parts." I put down in parenthesis "Diffendoe 1," in my own handwriting.

540. Q. Is there any other writing on this sheet, of yours?

A. Yes.

541. Q. What is it?

A. After carrying out this test, which was this recipe made up with Diffendoe 1 part, and after curing it, I put down the data obtained, which reads "Cure 30 minutes at 30 pounds, elongation 14½, tensile 2530, set ½.

542. Q. Is that cure reported in the X-book, and if so, where?

A. Yes, it is reported in the X-book, X 2010, column H. righthand sheet.

543. Q. Where has this paper been since you first received it?

A. It was among papers and notes that I kept in my possession all the time at my home. First it was among the notes kept at the Republic in my desk, and then taken with me and kept at my home.

By Mr. Wooster:

The original paper is offered in evidence as Plaintiff's Exhibit 5, "MYE formula."

CROSS-EXAMINATION.

By Mr. Edmonds:

X544. Q. You say this has been in your possession ever since it was made?

A. Yes, sir.

X545. Q. Why didn't you produce it in the National trial?

A. I didn't have it at that time, and I didn't happen to think of it and didn't look for it, but I found it subsequently among my papers.

X546. Q. It was in your possession all the time?

A. Oh, yes.

X547. Q. Don't you think the reason is that you saw it at that time when you were looking through your papers and looked at it and realized that it was of no consequence at all?

A. I didn't think of it at that time, but I did find it since that trial.

X548. Q. How does it happen that this didn't get burned up with everything else in the way of your personal records?

A. My personal records were at my home. The records of my work I kept at the plant, where I consulted them ever so often in conjunction with my work.

X549. Q. How did your personal records get burned up, if the fire was in the plant?

A. One of the notebooks contained records of the methods that I carried out at the Republic in producing guanidines.

X550. Q. That was in the fire and everything else was in your house?

A. Yes.

X551. Q. So the fire burned up the notebook and nothing else?

A. Nothing else.

MONROE H. DANIELS, a witness called on behalf of plaintiff, having been duly sworn testified as follows:

DIRECT EXAMINATION

By Mr. Woooster:

1. Q. What is your name, age, residence and occupation?

A. Monroe H. Daniels, age thirty-six, I reside in New York City. My occupation is superintendent and treasurer of the Gryphon Rubber Company, New York City.

2. Q. Where were you employed during the years 1918 and 1919, and first part of 1920?

A. The Republic Rubber Company, Youngstown, Ohio.

3. Q. What was your position there?

A. I was chief chemist in charge of development.

4. Q. Will you explain of what this development consisted?

A. The development consisted of finding new processes, utilization of new materials, and the investigation of a variety of things that had to do with our business.

5. Q. Do you know Morris L. Weiss, who is here present?

A. I do.

6. Q. When did you first meet him, and under what circumstances?

A. He was employed by us in 1917, to work in the analytical laboratory under Carlton.

7. Q. With what work was he engaged?

A. His first work was purely routine analysis, and such assistance as he could give to Mr. Carlton in Mr. Carlton's work.

8. Q. You are referring to Mr. Clinton A. Carlton?

A. Yes, sir.

9. Q. What did Mr. Weiss later do?

A. After Mr. Carlton left, Mr. Weiss had charge of the laboratory and it was his duty to take care of all routine work and put in whatever time he could in research.

10. Q. What kind of research?

A. In whatever problems that came to my attention, or anything that he had an idea about, that I thought should be carried out further.

11. Q. Do you recall any research Mr. Weiss carried out?

A. He continued some of the work that Mr. Carlton was engaged on, and right after Carlton left he was told to work on triphenalguanidine, the development process for the manufacture of T. P. G.

12. Q. What was the purpose of T. P. G.?

A. We wanted to develop another accelerator in the plant.

13. Q. What were you then using?

A. We were then using thiocarbanilid, which we then manufactured, paranitroso, which we also manufactured, hexamethylenetetramine which we produced.

14. Q. Did any of these materials have code or arbitrary names, and if so, what were they?

A. They were all coded. Hexa. had the code

name of "Mexa;" paranitroso was mixed up with aluminum flake, under the name of "Flaso," and thiocarbanilid had the name of "Cromite."

15. Q. Did Mr. Weiss work on any other accelerators than T. P. G., and if so, what ones?

A. Towards the end of 1918, he told me that he had an idea about the production of D. P. G., and I told him that if he had an idea, to go ahead, because I felt that we ought to have just as many accelerators in the plant, and have the use of them, as we could possibly get; and he went ahead and did some work, and I had a conversation with him, in which he told me he was working on it.

16. Q. Will you proceed with what Mr. Weiss did?

A. After he had prepared some, he told me that he had made some slabs and cures, and they looked pretty good. He showed me one or two of the slabs, and they impressed me. I told him to put whatever time he could on it, without hurting his regular routine work, and he agreed to do so. He said that the literature at hand wasn't sufficient to enable him to prepare it the best way, and he would like to look up some more of the literature, and for that purpose I told him he could go to Pittsburgh and go to the library there. That he did, and on his return he told me that he had gotten some more information, and I told him to go right ahead and use it, and put as much time to it as he could, and still keep the regular work going. I kept in touch with every member of the laboratory, that is, every head—I mean every man who did departmental work or who was responsible for departmental work, and I made a point of seeing

each of these men at least once a day, and during the early part of 1919 I talked to Weiss about D. P. G. in the course of conversation about routine and research work. I knew that the development was going on. I knew that he was trying what he had prepared in test recipes and other stocks. He prepared a fair amount of the accelerator, that is, D. P. G., which was kept in the compounding laboratory for such use as either he or I might make if it.

17. Q. Over what period did this work by Mr. Weiss on D. P. G. continue?

A. It continued during the spring and summer of 1919, and thereafter.

18. Q. To your knowledge, were any records made of this work?

A. I don't remember looking at any specific record. As I said before, I came in contact with the men in the laboratory and got my impression firsthand from conversation as to the progress of their work. I remember seeing the slabs and feeling them.

19. Q. Who showed you the slabs?

A. Mr. Weiss.

20. Q. What kind of a stock was it?

A. It was a zinc oxide test recipe, such as had been used for trying out various accelerators.

21. Q. When did he show you?

A. It was towards the end of 1918, or very early in the year 1919.

22. Q. Are these the only slabs he ever showed you?

A. I have a recollection of seeing some reclaimed rubber slabs cured with D. P. G., as the reclaimed rubber we made didn't always test uniform, I was

very much interested in finding something which would include the quality of the finished product and using our own reclaimed rubber.

23. Q. After Mr. Weiss showed you these slabs, what further work did he do relating to D. P. G.?

A. He continued to perfect the methods of production of D. P. G., both as to purity and method of production, so that we could get enough to do some real work.

24. Q. Did Mr. Weiss ever give you any D. P. G.?

A. He prepared several hundred grams, which were kept in the laboratory for his use and mine.

25. Q. When did he prepare this several hundred grams?

A. It was in the summer of 1919.

26. Q. Did you use any?

A. I don't exactly recall whether I used any for any specific compound. I had in mind the use of D. P. G. in inner tube work, and I wanted to replace the black splice with a splice that would match the color of the tube, the red tube. I had an idea, which I jotted down on a piece of paper, and I gave it to Bill Halliday in the laboratory to make up a cement for that purpose. The first one didn't work. The color wasn't any good at all, and I told Bill what I wanted done, as I didn't have time to work out everything in detail. I told Bill to take that same batch and keep adding color to it until it looked right, and told him to take the cement up into the plant, prepare pieces of tubes and make test splices.

27. Q. Was that done?

A. Yes, that was done.

28. Q. When?

A. I am not absolutely certain whether that was done in the summer or in the fall of 1919.

29. Q. Have you any records which would refresh your memory as to when these matters you have referred to were done?

A. There is a record in the X-book of the red inner tubes, and there is also one of the splicing cement.

30. Q. Which X-book is that?

A. That is the 1700.

31. Q. Who kept that book?

A. It was my book.

32. Q. Will you look at the book and pick out records you have in mind?

By Mr. Edmonds:

33. Q. X 1764, column D?

A. Yes. December 24, 1919.

By Mr. Wooster:

34. Q. In whose handwriting is this record X 1764 D?

A. That is mine. X 1773 A, B and C.

35. Q. What are the dates of these records, X 1773?

A. December 1, 3 and 11, 1919.—1777.

36. Q. Will you explain the entries on X 1777?

A. X 1777 was the result of the series of compounds that Mr. Halliday made up in the laboratory, in which he arrived at the right color.

37. Q. Have you any way of fixing the date when you wrote X 1777?

A. To my recollection, it was late in the year 1919, or early in the year 1920.

38. Q. Referring back to X 1764, in the first

column, under the letter G, I notice "Diffendoe (pure)." What does that mean?

A. That is a name we gave to diphenylguanidine dine as a sort of a code name, so that everybody would not know what is was.

39. Q. What is meant by the inscription at the top, "Match Norwalk tube"?

A. As I remember it, that was a tube made by the Norwalk Rubber Company, which had certain characteristics that were pretty widely advertised, and we wanted to match those tubes and put out something of the same quality.

40. Q. Referring to X 1773, opposite "Color," is the word "Poor," with three arrows, and opposite the date in the first column to the left of column A is an arrow in column A. Will you explain what those notations and arrows mean?

A. They mean the same as ditto marks; in other words, they refer to the preceding word or date.

41. Q. In X 1773, under the letter G, in the first column, is the word "diphenyl." What does that mean?

A. That is a name we gave to diphenylguanidine also. Until the material went right into the plant, we didn't have a final code name, because we didn't write a specification for it, and we didn't understand each other exactly, or we didn't agree exactly on the name that we were to give it. Sometimes it was diphenyl and sometimes Diffendoe.

42. Q. You mean the name you gave in your 1700 X-book did not always agree with the name that was given to the same substance in the 2000 X-book?

A. That is right.

43. Q. Referring to all these three X-book pages you have identified here, state whether or not they are in the same condition as when you wrote them?

A. No, they are not. They were in the book when I wrote them. They were bound in the book when I wrote them.

44. Q. Do you know how the sheets came to be cut out?

A. I was told by—

Mr. Edmonds:

Never mind. Let us have only direct knowledge.

A. I have no direct knowledge.

By Mr. Wooster:

45. Q. Other than that, how do the entries as they now appear compare with them when you made them?

A. On these specific pages they are, to my best knowledge, the same as when I made them.

By Mr. Wooster:

I ask that this book, being the property of the Republic Rubber Company, be marked for identification as Plaintiff's Exhibit 6. I offer in evidence as Plaintiff's Exhibit No. 7, page 1764; as Exhibit 8, I offer page 1773; as Exhibit 9, I offer page 1777.

By Mr. Wooster:

46. Q. Where did the diphenylguanidine come from with which these tests you have referred to were made?

A. Weiss prepared it.

47. Q. Then what did he do?

A. He prepared several hundred grams and had it in a bottle down in the compounding laboratory for future work. It was kept down there and was used as the compound showed.

48. Q. Can you fix the date as to when the several hundred grams of D. P. G. was in the bottle in the laboratory?

A. To the best of my recollection, it was in the summer of 1919.

49. Q. Do you recall any incident which fixes that date?

A. The first week in September I went down to Philadelphia to the open meeting of the American Chemical Society, and I had the D. P. G. before I went down there.

50. Q. How much did you have before you went to Philadelphia?

A. Several hundred grams.

51. Q. When did you leave the Republic Rubber Company?

A. April, 1920.

52. Q. When did Mr. Weiss leave?

A. March, 1920.

CROSS-EXAMINATION.

By Mr. Edmonds:

X53. Q. The accelerators that the Republic was using in 1918, and the first half of 1919, were unsatisfactory, were they not?

A. Each one had some characteristic that wasn't satisfactory.

X54. Q. You yourself appreciated the great need for something better than anything you had?

A. Yes.

X55. Q. And all through that time you were working on T. P. G., were you not?

A. Yes.

X56. Q. And that was the thing that your thought was centered on more than anything else, wasn't it?

A. You mean, through 1919?

X57. Q. Through the first half of 1919, the first eight months?

A. We were anxious to get into small plant production, so that we could get enough ahead, but I was never interested in accelerators in general, so that I could think of something else, and I did think of something else.

X58. Q. But T. P. G. was the thing that you thought most of?

A. Yes.

X59. Q. That looked most promising at that time?

A. Because we were nearer semi-plant production.

X60. Q. That was the thing that looked most promising, so you worked ahead on that, experimented with it?

A. Yes.

X61. Q. And that is the thing that Weiss was working on?

A. He was working on that and he was working on D. P. G.

X62. Q. But he was working on T. P. G. development?

A. Towards the middle, I think, of 1919, he got into a disagreement with Stephens, and I had to take him off active development of T. P. G., and Stephens, who claimed he had a process that he worked out with Eaton, really carried out a great part of the development of T. P. G., both in the laboratory and in the semi-plant production.

X63. Q. In that situation, you heard about this meeting that was to be held in September of 1919?

A. Yes.

X64. Q. And you sought permission to attend that meeting?

A. Yes.

X65. Q. You couldn't just order yourself to go, you had to get somebody else's authority?

A. Yes.

X66. And you sought that authority and got it?

A. Yes.

X67. Q. And you attended the meeting?

A. Yes.

X68. Q. You heard Dr. Kratz read the paper at that meeting?

A. I did.

X69. Q. That was in September, 1919?

A. Yes.

X70. Q. The early part of September?

A. Yes.

X71. Q. In the course of the reading of that paper, Dr. Kratz wrote out certain things on the blackboard which stood up in front of the audience?

A. Yes.

X72. Q. And among other things that he wrote

out on the blackboard were the tables that appear in the paper?

A. Yes.

By Mr. Wooster:

That is objected to as indefinite, no tables being identified.

By Mr. Edmonds:

X73. Q. To make it definite, I will call your attention to these tables labeled Table 1 and Table 2. Those are the ones that were posted on the blackboard?

A. Yes.

X74. Q. And you copied those?

A. I took notes.

X75. Q. The tables that you say were posted are Tables 1 and 2 in the paper presented at that meeting by Dr. Kratz, and prepared by him in association with A. E. Flower and Cole Coolidge, and published in the Journal of Industrial Engineering Chemistry, issued April, 1920. That is correct, is it not?

By Mr. Wooster:

Objected to. All this witness has stated is that these tables were posted on the blackboard by Dr. Kratz. He has not testified to any knowledge about Flower and Coolidge.

By the Court:

This was shown in a certain book containing an article, and he identifies those papers. That is as far as we had gone. We have to have some way to be able to identify these tables shown him.

By Mr. Edmonds:

That is the purpose of this question.

By the Court:

Simply that they are shown him in a certain exhibit.

By Mr. Edmonds:

I ask this paper just referred to be marked for identification Defendant's Exhibit "E", the tables to which the witness's attention was drawn being those appearing in the magazine on page 322, in the second column.

By Mr. Kennedy:

Plaintiff of course reserves the right to object when this paper is offered as an exhibit where it should be offered, in the defendant's case. Also reserves the right to deal with that paper as to its subject matter in its rebuttal, if that paper is offered in defendant's case.

By Mr. Edmonds:

X76. Q. When these tables were posted up in front of the audience, you wrote down in a code of your own the information given by those tables?

A. I made notes from the tables. I didn't copy them exactly.

X77. Q. Not all of them, but you copied parts, or copied data appearing there?

A. Yes.

X78. Q. Among other things, you copied enough to give you a record of your own of the information posted on the board, so far as it related to the relative accelerating value of certain of the substances, including D. P. G. and T. P. G. and anilin?

A. Yes.

X79. Q. And anilin was the substance which

you and everyone else in the rubber chemistry business were familiar with, so that you knew about its accelerating value?

A. I did not have a direct firsthand knowledge of the use of anilin. We did not use anilin at the Republic Rubber Company, and I hadn't worked with it to say any great extnt.

X80. Q. The table also included thiocarbanilid, didn't it?

A. Yes.

X81. Q. And you noted that?

A. Yes.

X82. Q. So that the figures therefore served as a comparison of D. P. G. with thiocarbanilid?

A. Yes.

X83. Q. Do you recall that in the course of the paper it was stated that D. P. G. was more active than T. P. G.?

A. Yes.

X84. Q. That was stated in the paper and shown by this matter posted on the board which you copied?

A. Yes.

X85. Q. With that memo in your possession, you went back to the Republic?

A. Yes.

X86. Q. And one of the first things you did when you got back there was to talk with some of the other officials, Mr. Clark and Mr. Jones, was it?

A. No. Mr. Clark only. Mr. Brown may have been there.

X87. Q. You don't remember whether you talked to Mr. Brown or not?

A. No.

X88. Q. But you talked with Mr. Clark?

A. Yes.

X89. Q. In your talk with him you tried to justify your trip to Philadelphia, didn't you?

A. I told him what I did.

X90. Q. And what you had gotten there?

A. Yes.

X91. Q. What did you tell him you had gotten?

A. I told him that I had been to a very interesting meeting, that I had gone to the Rubber Section meeting, and two of the open meetings, two of the other section meetings, and that I had heard pretty good papers in the Rubber Section concerning accelerators and other things, and that the paper by Kratz bore out the work that we had done previously and substantially our own ideas that we had arrived at before.

X92. Q. You reported to him that the Kratz paper was one of the most interesting papers you had heard on the subject of accelerators, didn't you?

A. I don't remember that definitely.

X93. Q. That is a fact, isn't it, you had never heard any paper on accelerators as interesting as that?

A. That is a fact.

X94. Q. Nor any paper that gave as definite information as that?

A. That is true.

X95. Q. In fact, up to that time, rubber chemists had rather refrained from publishing things about accelerators, hadn't they?

A. Yes.

X96. Q. And this paper of Dr. Kratz's marked a reversal of tendency in that respect, don't you think?

A. I think so.

X97. Q. Since then rubber chemists have been much more free in giving out information in printed papers read at the society meetings.

A. Yes.

X98. Q. As a matter of fact, some one of the men with whom you talked possibly Mr. Clark, knowing what difficulties you were having in devolping a process of making an accelerator that would be satisfactory to you, asked you if you had gotten the dope at the Philadelphia meeting, and you said yes, you had gotten the dope? Isn't that so?

A. As to the making of the accelerator?

X99. Q. Not as to the process; as to what would serve as a suitable accelerator?

A. I don't remember that.

X100. Q. You and everyone else realized that what you had in the way of accelerators was not as good as you wanted. As you said, they were unsatisfactory, and you of course were looking for a satisfactory one.

A. We were looking for more accelerators, each one of which would have its own characteristic suitable for our use.

X101. Q. You don't remember that some one asked you if you had gotten the dope, and you said you had?

A. I don't remember that.

X102. Q. Now, after this talk with Mr. Clark and possibly with Mr. Brown, you talked with Weiss?

A. Yes.

X103. Q. You showed him this note which you had made of Dr. Kratz's information?

A. Yes.

X104. Q. And you talked with him about that?

A. Yes.

X105. Q. And you said it looked to you as D. P. G. was much superior to T. P. G.?

A. I told him that Kratz's paper showed about the same results that we had gotten in general.

X106. Q. You said to him it looked to you as though D. P. G. had a great deal on T. P. G., to use your own expression?

A. I think I said that.

X107. Q. And you said you wanted him to do some work on D. P. G., didn't you?

A. I don't remember that conversation.

X108. Q. You said you wanted him to continue work on T. P. G., but you wanted him to work on D. P. G. also, didn't you?

A. I had given him that instruction long before that.

X109. Q. In the National case, in which you testified, you said, "I took a few notes of the meeting and called him, Weiss, into my office when I came back, and went over them with him and told him that it looked to me as though D. P. G. had a good deal on T. P. G., and while I would like to get the semi-commercial plant in production, I also wanted some work done on D. P. G." You recall testifying that way don't you?

A. Yes.

X110. Q. That statement as you gave it there is correct?

A. It is correct as it is, but my recollection is that I had talked to him long before that along exactly the same line. That was simply a repetition of what I had talked to him before. Whenever I had a conference with him, and D. P. G. came up, I encouraged him. I wanted him to go ahead.

X111. Q. As a matter of fact, from the time of that talk that you had with Weiss immediately after your return from Philadelphia, following this instruction that you gave him to work on D. P. G., there was a succession of tests with D. P. G. made in the Republic laboratory through the remaining months of 1919. That is true, isn't it?

A. Yes. We had more material to work with.

X112 Q. And you find all of those tests recorded in the X-book, do you not?

A. I haven't looked over the X-book for that particular purpose. I have identified my own.

X113. Q. Now, you were in charge of this laboratory where Weiss works?

A. Yes.

X114. Q. Did you say that the people under you, or do you say that the people under you, in that laboratory, were allowed to use their discretion as to what they made a report of?

A. No, I didn't say that.

X115. Q. I say, you don't say that now, do you?

A. No.

X116. Q. It was your instruction that they record everything in the books provided for that purpose?

A. Yes.

X117. Q. That was the rule of the company, was it not?

A. That was the rule. We had no written, definite, formal rules. We had certain instructions which were given to each man as he was engaged.

X118. Q. Was it your understanding that everything that was done in the way of testing rubber compounds was reported in the X-books that were provided for the purpose?

A. Yes.

X119. Q. If rubber tests were made and not recorded, it was not with your knowledge?

A. Yes, that is true.

X120. Q. And if you had known about it, you would at once have given instructions to have them recorded?

A. Yes. There were times when in the press of work—I know I have done it myself—that compounds were made up from notes and not recorded immediately. They were recorded a short time afterwards.

X121. Q. In the National case you were asked whether, following Weiss's trip to Pittsburgh, in January of 1919, you gave him any other directions as to investigating outside of the plant for this line of accelerators, and you said, "No, none that I remember. We were very much interested in triphenylguanidine. I had that in mind more than anything else." Do you recall testifying that way?

A. Yes.

X122. Q. And that is perfectly correct now as it was then?

A. I had triphenylguanidine in my mind more than anything else, because we had gone to the expense of putting up a small plant. I wanted to get that plant in production, but so far as research work,

getting new accelerators, is concerned I was also very, very much interested in D. P. G.

X123. Q. The active development work of the company was on T. P. G. up until the time you came back from that Philadelphia trip?

A. A small plant production, yes.

X124. Q. That was the active work in the development of accelerators?

A. Yes.

X125. Q. Do you recall any question being raised along in the summer of 1919, as to continuing Weiss's employment?

A. No, I don't.

X126. Q. You don't remember discussing with others there whether or not he should be continued in the employment of the company?

A. No, I have no recollection of that. In the summer of 1919?

X127. Q. Yes.

A. No, I have no recollection of that.

X128. Q. You don't remember discussing that with others like Mr. Clark and possibly Mr. Brown?

A. No.

X129. Q. Do you remember advertising for some one to take his place?

A. No.

X130. Q. No recollection of that at all?

A. No.

X131. Q. You don't know whether it was done or was not done?

A. No, I don't.

X132. Q. You and Weiss left at approximately the same time? Your services were discontinued by the company just as Weiss's were?

A. Within a month I resigned.

X133. Q. If anything new had been developed around the plant there, in the way of accelerators or chemicals generally, and had come to your attention, to whom would you have reported it?

A. I would have taken it up with Clark.

X134. Q. Did you ever take up this D. P. G. matter with him?

A. I think I did, yes.

X135. Q. Have you any definite recollection about it?

A. I think I talked that over with Clark in the spring or summer of 1919. I told him we were doing something with it, but I wasn't prepared to say how good it was.

X136. Q. I show you what I believe to be a copy of an affidavit signed by you and filed in the District Court of New York, in connection with the motion for preliminary injunction in the National suit. Will you look at that and state whether or not you recognize that as a copy of an affidavit signed by you?

A. Yes.

X137. Q. On page 2 of that affidavit there is a statement, as follows: "Upon said Weiss's return from Pittsburgh, Pa., I instructed him to devote as much time as possible in triphenylguanidine, as that substance was the one in which I was most interested at that time, although I consented to further investigation of diphenylguanidine as an accelerator." That statement you maintain is correct at the present time?

A. Yes.

X138. Q. Now, if you will remember, in the course of the proceedings in connection with that

motion, some of the affidavits referred to a man by the name of Eaton?

A. Yes.

X139. Q. And whether or not he had done certain things with D. P. G. at the Republic laboratory—

By Mr. Kennedy:

Objected to. It is not concerned with statement of things that this witness did.

By the Court:

He is simply making a statement. I cannot tell yet whether this has any relevency or not.

By Mr. Edmonds:

X140. Q. It was in that connection that you stated in this affidavit at the bottom of page 4, as follows: "I personally have no knowledge of his (meaning Eaton) working to any extent whatever on either triphenylguanidine or diphenylguanidine, which knowledge would naturally have come to me in the regular course of his laboratory work, if something had been included therein, and such work, if done by said Eaton, would have been reported in the laboratory X-book." That, of course, refers to Eaton. Would you not say just the same thing about Weiss, that his work done would appear in the X-book?

A. No.

X141. Q. You think there is a difference between Eaton and Weiss in that respect?

A. Yes; because Eaton was doing purely chemical work, with no compounding. Weiss was doing chemical work and compounding. He was testing out his resutls.

X142. Q. This statement about Eaton refers to a

claim by him that he had made a test slab of rubber with D. P. G. Now, if Weiss claims to have made a test slab of rubber with D. P. G. in it, wouldn't you say this same statement would apply with equal force to both, that if the work had been done it would have been recorded in the laboratory X-book?

A. As a theoretical question, yes.

X143. Q. Now, you recall that you sent Stephens to New York to search any the literature in the public library or elsewhere, along in the fall of 1919, and he went there in accordance with your instructions?

A. Yes.

X144. Q. You recognize as your own this letter that I now hand you, do you not?

A. Yes.

X145. Q. The letter is marked Defendant's Exhibit "F" for identification. At that time you were seeking information as to how to make D. P. G. in quantity at a cost that would permit of its use commercially?

A. I wanted more information as to the process. Stephens was the man whom we employed to do chemical engineering work; that is, he designed and constructed the semi work production plant, and I had talked to Stephens some time before that in the summer about the possibility, if T. P. G. would get to the point where it could be moved to a bigger plant, or it would be worth while making a bigger plant, whether the semi works plant could be shaped over to manufacture D. P. G.; in order for him to give me an idea of what it would mean in material and cost, he had to know something about the process.

X146. Q. It is evident to you from this letter, is

it not, that he reported to you while he was in New York, and his report indicated more or less about what he was doing?

A. Yes.

X147. Q. And you found evidently from one of his reports that he was doing some searching in connection with T. P. G.?

A. I asked him to.

X148. Q. And it is evident from this letter that he did do it?

A. Yes.

X149. Q. You wrote him in this letter that this T. P. G. you had been working on for months, was a dead issue, and you wanted him to stop work on that?

A. I didn't write him it was a dead issue.

X150. Q. Not in those words. You wrote him that you were through with T. P. G.—Those were the words?

A. That is right.

X151. Q. This thing that you had been working on for months and months, in trying to develop and make a commercial plant for, you were through with, and you told him to work on D. P. G.?

A. Yes.

X152. Q. To use your own words, you said, "That is the king-pin now."

A. Yes.

X153. Q. And that was shortly after the Kratz paper was read?

A. Two months.

X154. Q. Now, I wish to call your attention to another statement in this affidavit of yours, on page

6. Just after telling about your trip to this Philadelphia meeting, you said, "I did, however, upon my return from Philadelphia, immediately tell Mr. Weiss that the statements made in the paper read by said Kratz confirmed our experience with D. P. G., as to accelerating, and that we should continue to work on that substance and develop a commercial process if possible." That statement was correct when you made it and is correct now?

A. Yes.

REDIRECT EXAMINATION.

By Mr. Wooster:

155. Q. When you took Mr. Weiss off the work on T. P. G., what did he do?

A. He kept up with his regular routine work, and he did work on D. P. G.

156. Q. What kind of work on D. P. G.?

A. Development of the process of making it and testing it.

157. Q. Do you remember any feature of that process?

A. I remember the fact that he told me about the use of ammonium nitrate as a better material, rather more effective and cheaper material than using alcoholic ammonia, which would have been impractical.

158. Q. Relative to your trip to Philadelphia, when did he tell you about ammonium nitrate?

A. To my best knowledge, it was before.

159. Q. Is the Kratz paper the only paper you heard read at that Philadelphia meeting?

A. Oh, no.

160. Q. What other papers did you hear read?

A. There was a paper on accelerators by Mr. Scott, formerly of Goodrich. There was a paper by an assistant of Mr. Wiegand, about compounding materials. I think the heavier of certain compounding materials, when the resulting vulcanizing stock was stretched. He had a clever experiment, which I remember. There was a paper on the variability in crude rubber that I think Tuttle either gave or discussed.

161. Q. Did you hear a paper by D. F. Cranor?

A. Yes.

162. Q. What was that paper about?

A. That was on accelerators, and I think he compared assels also. I am not very clear on that.

163. Q. Did you attend a reading of other papers on chemical subjects than merely rubber or rubber compounding?

A. Yes, I attended the first open meeting in general and physical chemistry, and I looked in on the organic section once.

164. Q. What became of the T. P. G. plant which Mr. Stephens worked on?

A. He worked at it for a while, producing small quantities, and then I think when I found out that the company was running badly financially, I knew that a good deal of this sort of work would have to be stopped, and we stopped using the plant.

165. Q. Did the Republic Rubber Company, after you stopped using this plant, continue to use T. P. G.?

A. T. P. G. was never used to any great extent in the plant while I was there.

166. Q. Was T. P. G. offered in the market at this time?

A. I think it was.

167. Q. So that there were other sources of supply for whatever the Republic desired than merely what you made yourself?

A. Yes.

RECROSS EXAMINATION.

By Mr. Edmonds:

X168. Q. Do you know how much T. P. G. is used now?

A. No, I have no knowledge of that.

X169. Q. No idea at all?

A. I think a fair amount is used.

X170. Q. Do you think as much as 40,000 pounds a month are used?

A. Yes.

By Mr. Wooster:

X171. Q. When did you return from that 1919 chemical meeting at Philadelphia?

A. As soon as it was over; I think it was over on the 6th, and I was back on the 7th.

ARTHUR H. NELLEN, a witness called on behalf of the plaintiff, having been duly sworn testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation.

A. Arthur H. Nellen; age twenty-nine; Conshocken, Pa.; chief chemist and assistant superintendent of Lee Rubber & Tire Corporation.

2. Q. Where were you employed during the year 1919?

A. At the Republic Rubber Company, and also with the Firestone Tire & Rubber Company.

3. Q. Will you give the dates between which you were employed by the Republic Rubber Company?

A. February 1, 1919, to November 1, 1919.

4. Q. What was your position?

A. Compounder for mechanical goods, shaped, molded articles.

5. Q. Will you name those articles, or some of them?

A. Small miscellaneous molded mechanical goods, such as plumbers' supplies, heels, soles, and so forth, and also handmade articles, such as packers and wringer rolls.

6. Q. At this time were you familiar with the nature and operation of rubber accelerators?

A. Yes.

7. Q. Did you use them in your own work?

A. Yes.

8. Q. Which ones did you use?

A. Thio. and hexa.

9. Q. What were the code names, if any, for those?

A. Cromite and Mexa.

10. Q. Are you acquainted with Morris L. Weiss, who is here present.

A. Yes.

11. Q. When did you first meet him?

A. Late in 1917.

12. Q. Where?

A. Youngstown.

13. Q. When did you next meet him?

A. February, 1919.

14. Q. Where?

A. Youngstown.

15. Q. At what place?

A. The Republic Rubber Company's factory.

16. Q. Was he ever employed there?

A. Yes.

17. Q. While you were there?

A. Yes.

18. Q. Did you and Mr. Weiss ever discuss accelerators?

A. Yes.

19. Q. Did he ever disclose any accelerator to you?

A. Yes.

20. Q. What was it?

A. D. P. G.

21. Q. Meaning—

A. Diphenylguanidine.

22. Q. When did he make such disclosure?

A. I don't remember.

23. Q. Between what dates did he make it?

A. Between February 1, 1919, and November 1, 1919.

24. Q. I show you Plaintiff's Exhibit 5, and ask you if you recognize it.

A. Yes.

25. Q. What is it?

A. It is a formula for a stock used at the Republic Rubber Company for making a certain grade of packers, used in oil wells.

26. Q. State what you know about this paper?

A. Some time during the time I was employed at

the Republic Rubber Company in 1919, Weiss discussed D. P. G. with me, in relation to using any cheap shoddy compound, and he asked me at that time for a formula which he could use, which would make a practical factory test on D. P. G., and I scratched off this formula and gave it to him.

27. Q. State which is your handwriting on this exhibit?

A. Just the letters "NYE" at the top and the line. That and also the actual formula totals 100. That is all. That is the names of the ingredients and the percentages.

28. Q. What does "NYE" mean?

A. Those are the letters that were given as a name to the stocks when they were actually used in factory production.

29. Q. What does "Cromite 4" mean?

A. Four per cent of Cromite in the formula.

(No cross examination.)

WILLIAM HALLIDAY, a witness called on behalf of plaintiff, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. Please state your name, age, residence and occupation?

A. William Halliday; Hubbard, Ohio; age fifty-six; occupation, railroad and utility man.

2. Q. Where were you employed between April, 1914, and March, 1922?

A. Republic Ruber Company, Youngstown, Ohio.

3. Q. What was your position at the Republic Rubber Company during this time?

A. Well, I guess you would call it physical work for research chemists. I never knew a name for the position.

4. Q. What did you do?

A. I weighed the compound and then mixed it in the mixing mill, and then took the stock and cured a sample of the rubber, as per their request.

5. Q. What substances did you use in mixing the rubber?

A. Whatever they had written on the paper. I couldn't keep track of those.

6. Q. Do you remember some of the names they wrote down?

A. Quite a number of them.

7. Q. Give them?

A. Smoke sheets, para rubber, Ceylon, Borneo, and different groups, brown crepe No. 1, 2 and 3, zingu, possibly there were another one or two, but I have forgotten. There were a lot of shoddies that were named A, B, C, D, E, F, G, and also some other names, usam. I don't believe I can recall any other now. A lot of compounds, aluminum flakes, zinc, ponolith, different clays they had samples of. There was a large number of those that I could refer to by just stepping into the room. Every article I had was indexed, so that I could get the names of any article and refer the recipe to the name, and get the ingredient I wanted.

8. Q. Did you ever know of any substance there as "kickers"?

A. I sure did.

9. Q. What were they?

A. It was a compound that we always added in a small quantity to shorten the time and amount of heat used to cure a piece of rubber.

10. Q. Do you remember some of the names of these kickers?

A. Yes. The first one was cromite, that I got familiar with, and it followed up with difan, diffendoc, and flaso, or flakes, and D. P. G. I believe that is all I can recollect at present.

11. Q. Do you know Morris L. Weiss, who is here present?

A. Yes.

12. Q. When and where did you meet him?

A. At the Republic Rubber Company, during the latter part of 1918, it runs in my mind. I wouldn't state positively just the exact time. It was when he first took the job there that I met him first.

13. Q. What did you have to do with him?

A. Merely to satisfy his requests as far I could That was all. If he made a request to mix a compound, cure samples for him, it was my duty to do so, and turn the slab over to him, or whatever he should require in the way of curing and mixing rubber.

14. Q. Will you state what his custom or varying customs were, as to giving you instructions on materials?

A. Well, I considered him a very secretive fellow, and for a time was not very friendly toward him on that account. I had obtained the confidence of every one of the fellows, and I was rather sensitive about his secretiveness, and I endeavored not to hand him any favor, only just directly what he asked. Then

possibly two months or something like that later, he became more friendly with me, and I made up my mind I was going to find out what had happened to samples that he had me cure for him, and that I was going to win his confidence. So began getting more friendly with him.

15. Q. Referring to these samples you just mentioned, did he bring you a compound all milled and ready to cure, or part of it, or tell you what to do?

A. He had it weighed, and that irritated me, I remember distinctly, because it looked to me in the face of it that he wouldn't trust to my weighing. He weighed it, and he set it down alongside of the mill, and called across the room to me, and said, "Bill, when you get ready to mix this, call me. I would like to watch it mix." I delayed it until possibly three o'clock in the afternoon, and that I think was immediately after lunch, if I am not mistaken, when he placed it by the mill. I had thrown the rubber into the mill and was breaking it down, and I called him, and he came downstairs immediately with a small beaker in his hand with some white powder in the bottom of it, and he said, "Tell me when you want to throw this in." I said, "Throw it in the compound, put it all in together." He threw it in the compound, and after I got my rubber broken down, I went on with it and took it off. In the meantime I asked him what kind of a sample he wanted cured. He said a slab, a 3/32. That is the way I determined what samples he wanted. Then I sheeted the rubber as I took it off the mill, according to the requirement of that sample. I removed that and got the shape to make a 3/32 slab, and laid it on the table, and he followed me around

and asked me to make a cure for him, and I did that. I said, "Put that on a piece of paper, because I can't handle that this evening." I remember now I couldn't handle it, I wouldn't have time in the length of time I had. It seemed to me it was about an hour. The length of time had been getting to run past my quitting time, and he asked me if I would do it the first thing in the morning, and I said I would at seven o'clock in the morning. So I placed that in the press in the morning, and when the time came to remove it, it broke right off in my fingers. I said, "You have something pretty rotten here," and threw them on the resk and said, "How do you like that?" And I walked away and went downstairs and went on with my other work. Possibly fifteen or twenty minutes after that he came running down and asked me if would give him another cure on that, and I said "Sure." So he gave me another to cure, which was diminished, it seems to me, fifteen or twenty minutes, with the same pressure of steam. I made that cure. I imagine that came at just lunch time. Yes, I waited two or three minutes after the whistle blew to remove it from the press, and I threw it on the table and went to lunch, and when I came back he said, "Is that other cure off?" I said, "There it is on the table." He took that upstairs himself and late in the afternoon told me he would like another cure, or rather in the middle of the afternoon, possibly two o'clock. I asked him, "How much time do you want on it?" And it was something like twenty minutes or twenty-five. I know he cut it more than half in two from the original cure. I made that cure for him immediately and took it upstairs to him, and he thanked me for it, and I went on with my work.

16. Q. Did he tell you what the name of the white powder was?

A. Not on your life, no.

17. Q. You mentioned in the previous answer difan, diffendoe, difenylguanidine. When did you first hear those terms?

A. It was a long time after that that I got familiar with those. Possibly the next spring or summer that I became familiar with those names, and I didn't have any of that in stock at that time. It was later. Just at that time, it is on my mind, I became familiar with the word "triphilum," which I considered was an accelerator. I can't remember of anyone ever telling me it was, but I considered it from my own personal experience as being an accelerator.

18. Q. Who made known to you the terms diphenyl, diffendoe, diphenylguanidine?

A. That occurred when I would get a quantity. They would say, "We will call this so-and-so," and sometimes it would be one and sometimes another. Just who gave me the individual names I don't believe I am able to answer, as I had seven or eight fellows to deal with continuously that were coming in on me every fifteen or twenty minutes, and it slipped my mind just who would give me the names.

19. Q. At any time did you ever have in your place any quantity of diphenyl or diffendoe, diphenylguanidine?

A. Diffendoe I kept in a tin box that was eleven inches high and seven inches in diameter. It was called diffendoe. It was a white, grayish powder, and I marked with yellow crayon chalk on the can what the ingredient was.

20. Q. Can you recall when you first had that material there?

A. It was in 1919, I believe, that I obtained that large can.

21. Q. Where did you obtain it from?

A. It came from upstairs. Mr. Weiss, I believe, brought it down and told me that Daniels said it would be called diffendoe.

22. Q. Who do you mean by Daniels?

A. Mr. Daniels, the chief chemist. He was my foreman.

23. Q. How did this powder which you call diffendoe compare in appearance with that which you first used, as brought to you by Mr. Weiss in the beaker?

A. Nothing only in appearance, and I never classed them together at all. I didn't know it was the same thing, because I had nothing to do with it, only to watch him drop it in the can. It was all a mixture of compound after that.

24. Q. Do you recall any incident which refreshes your memory as to when this first set of cures with the white powder brought to you by Mr. Weiss was made?

A. Yes; that was in the winter, either the latter part of 1918 or the early part of 1919.

CROSS-EXAMINATION.

By Mr. Edmonds:

X25. Q. In this rubber batch that you said he made these three slabs from, did you measure out the ingredients and put them together?

A. No.

X26. Q. You had nothing to do with that at all?

A. Not with that, no.

X27. Q. Have you any way of telling how much sulphur was in that compound?

A. None whatever.

X28. Q. You didn't know anything about that?

A. No.

X29. Q. How large was the original batch?

A. That was half a batch. I remember he spoke to me first about letting him know. He said, "Can I use a thousand grams on that?" I said "I don't know what you have in it." He said, "I have only got ten grams"—no, five grams, he said. It was a very small quantity.

X30. Q. I asked you how much the batch was?

A. Five hundred grams.

X31. Q. Do you recall which side of the mill Mr. Weiss stood on as he talked with you?

A. On my righthand.

X32. Q. How do you recall? He had his left hand in his pocket too? Don't you recall that?

A. I do not. My back was to him. I wasn't looking at his hand.

X33. Q. Do you remember he stood on the left-hand side of the machine?

A. No, on my right-hand.

X34. Q. That was when he first came up and spoke to you?

A. No.

X35. Q. Where did he stand then?

A. I was working on my table on other work when he came down and approached me then. At the same time he was talking. That was before the compound was brought to me at all.

X36. Q. Both days when he came down and talked to you—

A. The same day.

X37. Q. And the second day he came down and stood on the same side of the machine?

A. It was all the same day, within a few minutes.

X38. Q. All this happened within a few minutes?

A. Yes.

X39. Q. The making of these three batches?

A. One batch.

X40. Q. This one batch you made in a few minutes?

A. Yes, sir.

X41. Q. About that time you were running these batches through the mill time after time, weren't you?

A. There was only the one batch.

X42. Q. I am talking about your general work. That was what you were doing right along, making batches of rubber of that sort?

A. A part of the time I was occupied in pressing the samples and curing.

X43. Q. For instance, about how many batches would you say you would make up and run through the mill each week?

A. A week?

X44. Q. Yes.

A. I never estimated it.

X45. Q. Do you think it would be about ten?

A. Oh, fourteen or fifteen in one day.

X46. Q. Fourteen or fifteen in one day?

A. Yes.

X47. Q. And that continued through the years 1918 and 1919?

A. Yes.

X48. Q. And 1920?

A. Yes.

X49. Q. Also 1921?

A. Yes.

X50. Q. And 1922, until you left?

A. Yes.

X51. Q. It was also true during 1917?

A. Yes.

X52. Q. And 1916?

A. Yes.

X53. Q. You would average about fifteen a day?

A. Very close to that. It possibly would have been lower for an average. I have reached as high as thirty-one in one day. The minimum I have seen as low as four or three, maybe.

X54. Q. When you put through as many as thirty-one a day, it kept you going pretty strenuously?

A. I think so, and I called for assistance.

X55. Q. And that would run right through the week of six days?

A. Yes.

X56. Q. And week after week all through the year?

A. Yes.

X57. Q. In the course of a year you would run up into thousands, probably?

A. I would say so.

X58. Q. Possibly many thousands.

A. If I looked at it that far away, I would get groggy.

X59. Q. You made many of these tests at Mr. Weiss's request, didn't you?

A. Yes, quite a large number.

X60. Q. It was quite the usual thing, that is, he was one of the chemists for whom you had to do these things?

A. Yes.

X61. Q. About how many of these chemists were there that you made these tests for?

A. Do you mean, throughout my entire experience?

X62. Q. At one time, at any one time.

A. Well, sometimes four and sometimes five; I believe it reached six at one time, if I am not mistaken.

X63. Q. If there were six of these chemists, you made thirty tests in one day—Each one of these chemists would average five?

A. But it didn't average up at all.

X64. Q. Fourteen or fifteen would be more of an average.

A. Lots of times I would have one from a man and other times I would run four or five for the same man.

X65. Q. The same day?

A. Yes. And I have seen Mr. Daniels, where we were running for color—one day we ran fourteen, but not all mixtures, that is, a complete mixture.

X66. Q. All fourteen for one man?

A. Yes, by merely taking that piece of rubber back to the mill and adding some more color. In that case it would be a very small piece of rubber, an inch wide and six inches long. He was keeping

track of the percentages that I was getting with that on request.

X67. Q. Sometimes you would do that for Mr. Weiss?

A. Not as elaborate as that.

X68. And he would stand there by the machine?

A. No, only that one time that he gave such a thorough examination.

X69. Q. I mean, when you made the series of tests when they would change the percentage of each time, would he stay there?

A. No, he would give me the recipe and ask me to get at it at my earliest convenience. Then I would weigh the compounds and mill them to what I thought would satisfy him. I didn't call him after that.

X70. Q. You were there with the Republic about eight years?

A. Yes, from 1914 to 1922.

X71. Q. You must have made as many as 50,000 tests in those eight years, don't you think.

A. I don't know. That may be pretty strong, because I haven't placed that average at thirty. That average might be nearer fifteen, even as low as twelve possibly an average would be struck.

X72. Q. That would be about a hundred a week? and five thousand a year, and that would make about forty thousand tests?

A. Maybe it reached that, but I never gave that a thought.

VAN LEAR WOODWARD, a witness called on behalf of plaintiff, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation?

A. Van Lear Woodward; New York City; thirty-five; vice president of Dovan Chemical Corporation.

2. Q. That is the plaintiff here?

A. Yes.

3. Q. When was the plaintiff corporation formed?

A. In February, 1921.

4. Q. To what business did it succeed?

A. It succeeded the partnership comprised of M. L. Morris, H. F. Doty and Van Lear Woodward.

5. Q. When was this partnership formed?

A. In April, 1920.

6. Q. Did you hear an agreement mentioned yesterday in the testimony of Mr. Weiss of that date?

A. I did.

7. Q. Is that the agreement under which the partnership was formed?

A. It is.

8. Q. When did you first meet Mr. Weiss?

A. The latter part of March or the very first few days of April, 1920?

9. Q. What was the occasion of that meeting?

A. Mr. Weiss was brought into my office by Mr. Doty, and he discussed with us the chemical sub-

stance that he had as an accelerator for the vulcanization of rubber.

10. Q. Did he tell you what it was?

A. He did not tell us what it was.

11. Q. Did he tell you what it was before the agreement was signed?

A. At the time the agreement was signed, he told me what it was.

12. Q. Did the partnership engage in any business?

A. Oh, yes.

13. Q. What was its business?

A. Manufacturing and selling diphenylguanidine.

14. Q. Commenced when?

A. Our first production was at the end of July or the first few days of August, 1920.

15. Q. At this time was any other manufacturer offering diphenylguanidine in the market as an accelerator for the vulcanization of rubber?

A. No.

16. Q. How many pounds of D. P. G. was made during the year 1920, approximately?

A. Approximately 200 pounds.

17. Q. How many pounds were sold?

A. Fifty-three pounds.

18. Q. What became of the rest?

A. We gave it away as samples.

19. Q. To whom?

A. To rubber manufacturers that we were endeavoring to interest in the use of the product.

20. Q. To how many rubber manufacturers did you distribute samples?

A. Seventy-five to eighty.

21. Q. What was the response?

A. At that time?

22. Q. At that time.

A. The response was very slow. They wanted to further test it out before they would consider its use.

23. Q. Did they ask any questions about it?

A. As to what it was, very much so.

24. Q. Anything else?

A. They wanted to know what its nature was, what it would do, what its cost was, what we knew of it as to the results that could be obtained from it—information along those lines.

25. Q. Anything else?

A. I can't recall specifically anything else they asked.

26. Q. What do you mean by "nature?"

A. Whether it was a powder or whether it was a gum, or whether it was finely divided, whether it was white or black.

27. Q. Were you ever asked if it was toxic?

A. Yes, that was a very usual question.

28. Q. Why was that?

A. Because the accelerator then most commonly used was known to be very poisonous to the men using it.

29. Q. What was that?

A. Hexamethylenetetramine.

30. Q. What other accelerators were on the market at the time, in 1920, when you offered D. P. G.?

A. Paridianinodiphenyl, thiocarbanilid, lead ole-

ate, small quantities of paranitroso, and small quantities of triphenylguanidine.

31. Q. Did you ever contemplate the manufacture of triphenylguanidine?

A. I did.

32. Q. When?

A. In 1918.

33. Q. Did you go into it?

A. We erected a plant for the commercial production of it, but we never produced or sold it commercially.

34. Q. What was the experience of the Dovan Chemical Corporation, commencing from its incorporation, in February, 1921, and the preceding experience in 1921, of the partnership, as to the pushing of D. P. G.?

By Mr. Edmonds:

I offer the objection that it is all irrelevant and immaterial.

By the Court:

You are entitled to show his experience to some extent. The objection is overruled.

A. The Dovan Chemical Corporation continued its sales efforts through the States Metals Company, and commencing about the middle of the year 1921 developed ever-increasing and rapidly-increasing sales to rubber manufacturers of diphenylguanidine.

35. Q. Subsequent to 1921, what happened?

A. Right up to the present time we have produced and sold each year considerable more than our production and sales of the previous year.

CROSS-EXAMINATION.

By Mr. Barrows:

X36. Q. The Dovan Chemical Corporation is not engaged in the vulcanization of rubber, is it?

A. Not commercially.

X37. Q. It never operated commercially under this patent in suit, in carrying out the process of this patent.

A. It has never made rubber articles for sale to the public.

X38. Q. Its purpose is the manufacture and sale of D. P. G.?

A. Yes.

X39. Q. And you manufacture it by your own special process or processes?

A. Yes.

X40. Q. And that process is the subject matter of another patent owned by this plaintiff?

A. The process we have used is the subject matter of a patent.

X41. Q. A patent of the same patentee of the patent in suit?

A. Yes.

X42. Q. The patent which is referred to in the patent in suit, or the application which is referred to in the patent in suit?

A. I don't get the question.

X43. Q. The other patent under which plaintiff is operating is referred to in the patent in suit, or identified by this application.

A. The patent on the process of the manufac-

ture of D. P. G. is referred to in the patent in suit, and it is a process that we have used.

X44. Q. It is a process on which your first manufacture of D. P. G. was based, isn't it?

A. Yes.

X45. Q. And you never would have gone into the business if you hadn't had a process for making it commercially?

A. Very probably not.

X46. Q. So far as you know, there was no other process available at that time for making D. P. G. commercially?

A. I didnt know of any.

X47. Q. You referred to sending out letters to the trade at the time you began business. You have been sending out similar circulars ever since, or at different times since then?

A. Yes.

X48. Q. Do you recognize this as one of the circulars which you sent out?

A. That is a pamphlet that we distributed.

X49. Q. How long ago?

A. 1923.

X50. Q. This contained recommendations that you were making to the trade at that time?

A. As a type of compound.

X51. Q. And information that would be of value to the trade?

A. Of general interest, not specific interest.

X52. Q. In this pamphlet it is stated that "D. P. G., unlike many other accelerators, is very active when present in very small amounts, and its activity increases almost proportionally to the increase of

D. P. G. up to about .75 parts with 100 parts of rubber." That statement is one of the recommendations or pieces of information you supplied to the trade?

By Mr. Wooster:

Objected to. Witness is not qualified by the direct examination to answer cross-examination of the nature of expert testimony.

By the Court:

Ask him if that was a circular they sent.

By Mr. Edmonds:

The question is withdrawn. I ask that the circular be marked Exhibit "G" for identification.

X53. Q. You have acquired a great deal of information about D. P. G. since 1920 that you didn't have then?

A. Yes.

X54. Q. And the circulars you sent out in 1920 were not nearly as complete or informative as the circulars you sent out more recently.

A. I am not generally familiar with technical circulars. If you will refer to letters that I wrote myself, I will discuss them.

X55. Q. I show you one of the circulars which was filed during the Patent Office proceedings as Exhibit "C," attached to an affidavit which I think you just identified. This is one of the circulars that you sent out in August, 1920, or had sent out on your behalf?

A. The letter was sent by our Akron representives.

X56. Q. With your knowledge and approval.

A. Yes.

X57. Q. And one of the things that you pointed out in this letter was that D. P. G. could be obtained at a price that made it available as a commercial accelerator?

A. Yes.

X58. Q. And that you were in a position to supply quantity production?

A. Yes.

By Mr. Edmonds:

I ask this be marked Exhibit "G" for identification, the sheet referred to being the sheet that has just been shown to the witness, and which forms a part of the file record of the patent in suit, as an exhibit annexed to an affidavit of Henry S. Doty.

X59. Q. You say you first met Mr. Weiss, the patentee of the patent in suit, late in March or early in April of 1920?

A. Correct.

X60. Q. And the first time he came to see you he gave you a sample of material, but he didn't tell you what it was?

A. That is right.

X61. Q. What did you do with that sample?

A. Mr. Doty had possession of the sample.

X62. Q. Do you know what was done with it?

A. I know from what Mr. Doty told me, that he tested it.

X63. Q. And then you thought the test pretty good?

A. We considered the test very good, in the light of Mr. Weiss's remarks to us at the time he gave us the sample.

X64. Q. And then you and Mr. Doty and Mr. Weiss came to an agreement and went into business.

A. Yes.

X65. Q. Those tests were the ordinary tests of a rubber chemist in mixing the accelerator in the rubber compound and testing it in the laboratory.

A. I prefer not to state specifically what the tests were.

X66. Q. So far as you know, it was the ordinary test of rubber chemists.

A. As far as I know, they were tests that Mr. Doty applied to that sample, in accordance with suggestions given by Mr. Weiss.

X67. Q. And the test, together with what Mr. Weiss told you, satisfied you that this was something worth going into?

A. Yes.

X68. Q. Did Mr. Weiss tell you that he also had a new process for making this, which would enable you to make it commercially?

A. I wouldn't recall whether that was discussed at the first meeting, but probably it was.

X69. Q. I hand you a file wrapper of the patent in suit, of which an affidavit of yours forms a part, and ask you to examine this affidavit and see if you recognize it?

A. It is my signature.

X70. Q. In this affidavit it states, "On or about April 7, 1920, Morris L. Weiss, the above named ap-

plicant, called at my office, No. 30 Church Street, New York City, and explained to myself and Henry S. Doty the invention set forth in said application. At said time this said Weiss delivered to said Doty and myself a sample of diphenylguanidine and explained to me and said Doty the manner and method of using the same as an accelerator in the vulcanization of rubber articles. Thereupon, said Doty agreed to make tests of said sample in the vulcanization of rubber, and on or about April 8, 1920, said tests were conducted by said Doty, at the Laboratories of the States Metals Company, Long Island City, New York. Immediately thereafter I was advised by said Doty that said tests had proved entirely satisfactory and the results obtained therefrom, using the same as an accelerator in the vulcanization of rubber, were superior to the results obtained when using hexamethylenetetramine. In view of the results of said tests, said Weiss, Doty and the deponent agreed to cooperate in the manufacture and sale of diphenylguanidine as an accelerator. Do you now say that when Mr. Weiss called to see you and handed you the sample of D. P. G. that he did not disclose to you that it was diphenylguanidine?

A. At the time he gave us the sample he did not disclose it.

X71. Q. Then when you say that he explained the invention to you, you mean that he gave you a sample and didn't tell you what it was?

A. Gave us a sample, which he said was an accelerator for the vulcanization of rubber, that he had tested it out, and was familiar with the properties of the rubber that could be produced by it, its physical

effects on that rubber, and that the only way for us to prove it to ourselves was to try it out ourselves. But he did not say the specific name of the chemical.

(Recess).

AFTERNOON SESSION.

Friday, October 9, 1925.

VAN LEAR WOODWARD resumes the stand.

CROSS-EXAMINATION (continued).

By Mr. Barrows:

X72. Q. Mr. Woodward, in order to avoid any ambiguity, I hand you copy of Weiss patent No. 1422506, granted July 11, 1922, assigned to Dovan Chemical Corporation, and ask you if that is the patent under which the Dovan Chemical Corporation began the manufacture of D. P. G.?

A. We only have one patent on the process of D. P. G., so that must be it.

X73. Q. This process was disclosed to you at the time or shortly after the time when you first met Mr. Weiss in 1920, and at or before the time you made your first agreement with him?

A. No, it was not.

X74. Q. This process was not?

A. No.

X75. Q. When was it disclosed to you?

A. After we had made the agreement.

X76. Q. Mr. Weiss had told you before that that he had a process for making it commercially?

A. For making the substance that he offered us commercially, yes.

X77. Q. Now, when you began making it you sold it through agents?

A. That is right.

X78. Q. And you gave to the purchasers the right or license to use it for vulcanizing rubber?

A. That is what we sold it for.

X79. Q. Now, when you first put it on the market you concealed its chemical identity?

A. You might call it that.

X80. Q. And sold it as a secret compound?

A. Sold it as X. L. O.

X81. Q. But the people to whom you sold it were not told what it was?

A. No, they were not.

X82. Q. Were you trying to keep that secret at that time?

A. To some extent.

X83. Q. As much as you could?

A. Until they asked specifically what it was, and then we told them.

X84. Q. When you sent out your circulars in 1920, and your first samples of X. L. O., what instructions did you give the rubber companies as to how to use it—anything beyond what was in your circulars?

A. Yes, we told them to use it in varying percentages on the rubber, depending on the type of product they were to make; they would range anywhere from a half per cent to four per cent.

X85. Q. And then you expected them to make the regular routine laboratory tests, to see what par-

ticular amount was required and what condition of cure for any particular compound they were interested in?

A. So far as possible, we asked them to give us details as to the compound they wanted to use it in, and we would have our own laboratory work out the proper proportion—what we thought was the proper proportion, and submit that report to them.

X86. Q. And the work you would do in your laboratory was the ordinary routine testing for accelerators of that particular compound?

A. Determining the correct amount of accelerator for that compound.

X87. Q. At the time of the Aniline trial, I believe you or Mr. Doty said that the sole business of the plaintiff at that time was the manufacture of D. P. G. That is correct, is it not?

A. That is correct.

X88. Q. Is that still so?

A. Including in that to cover di-substituted guanidines now, because we are selling limited quantities of another di-substituted guanidine.

X89. Q. That is, since the first trial and the present trial you have added another accelerator to the business of the company?

A. Yes.

X90. Q. And the sole business of the company at the present time is making these two accelerators?

A. That is right.

COLBY DILL, a witness produced on behalf of the plaintiff, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation?

A. I have just given my name; my age is forty-two; I live in Woodbridge, N. J.; my occupation is director and acting superintendent of the Roessler and Haslacher Chemical Company, and I have some other positions with other companies that are affiliated with that company.

2. Q. How long have you been connected with the Roessler and Haslacher Chemical Company?

A. Since January, 1908.

3. Q. During your connection with this company has it manufactured and sold accelerators for the rubber trade?

A. Yes.

4. Q. Will you give the names of some of them, with the approximate years when they were put on the market?

A. Hexamethylenetetramine we have been manufacturing and selling for about twenty years. We first sold it as an accelerator about ten years ago. We also sold, beginning about that time, thiocarbanilid, anilin oil, and subsequently aldehyde ammonia, D. P. G., and three or four others.

5. Q. When did you commence to market D. P. G.?

A. I think we took the first order in the spring of 1922.

6. Q. Have you since marketed it in quantity?

A. Yes.

7. Q. What led your company to market D. P. G.?

A. Because our salesmen reported to us that our customers wanted it.

8. Q. Are you familiar with patent to Weiss No. 1411231, here in suit?

A. Yes.

9. Q. Were you notified not to infringe this patent, shortly after it was issued?

A. Yes.

10. Q. What did you do about it?

A. Why, I either called up or wrote a letter to the Dovan Chemical Corporation and had a meeting with them.

11. Q. What was the result?

A. The eventual result was that we entered into an agreement with them.

By Mr. Edmonds:

I object to any oral testimony from this witness about any license agreement between these two companies, if that is what he is to be questioned about. His oral statement would obviously not be the best evidence, and that is a matter on which primary evidence only is admissible.

By the Court:

The answer is probably preliminary to something that is of importance in itself, as I see it. We will not strike out the testimony at this time.

12. Q. Have you a copy of that agreement with you?

A. There is one in the room here. I might say I am willing to produce this license agreement, but there are some matters in it which I am not sure my company would like to have made a matter of public record.

By Mr. Wooster:

I suggest we have the agreement produced for the inspection of the Court and counsel, and agree as to parts of it to be used.

By the Court:

What do you expect to prove?

By Mr. Wooster:

Acquiescence in this patent by this company.

By the Court:

Not a party to the suit?

By Mr. Wooster:

Not a party to the suit. A very important part of the case.

By Mr. Edmonds:

All of this, I maintain, is irrelevant.

A. I think that is the copy there (indicating document).

13. Q. What is the date of this agreement?

A. July 8, 1922.

14. Q. Under this agreement has your company paid royalties or other consideration to Dovan Chemical Corporation?

By Mr. Edmonds:

Is this agreement going to be offered in evidence?—Before the witness answers, may I ask if this agreement is to be offered in evidence?

By Mr. Wooster:

I would like to make the same stipulation that we did about the Weiss employment contract —that certain parts of it may be used, if you will agree.

By Mr. Edmonds:

I probably will agree to eliminate any parts that you do not want to have made public, but I want to see for myself, to see if I do agree to that. I haven't any desire to expose the private affairs of any of these companies, but I want to know what is in this agreement.

15. Q. (Question read).

A. Yes. I might explain at this point that that agreement is between the Dovan Chemical Corporation and the Perth Amboy Chemical Works, which is a subsidiary of the Roessler and Haslacher Chemical Company, that I first mentioned.

16. Q. And has not the Perth Amboy Chemical Works, since the date of this agreement, been absorbed into the Roessler & Haslacher Chemical Company?

A. Yes, sir.

17. Q. And the Roessler & Haslacher Chemical Company is the successor of Perth Amboy Chemical Works?

A. Well, that is substantially the situation. I

am not an attorney and I don't know whether that is the proper form to apply.

18. Q. Well, it took over its business and assets and good will?

A. Yes.

19. Q. State the approximate amount of money paid by your company under this agreement to Dovan Chemical Corporation?

A. It was over $90,000.

CROSS-EXAMINATION

By Mr. Edmonds:

X20. Q. Has your company paid license fees under this patent since the summer of 1923?

A. We have paid no license fees since the time when the last suit was definitely settled—definitely decided.

X21. Q. That is, since the Circuit Court of Appeals of New York—the Circuit Court of Appeals of the Second Circuit held the patent to be invalid, you have paid nothing?

A. No.

X22. Q. My statement is correct,—you have not paid anything?

A. Well, I understand your statement was substantially the same as mine.

X23. Q. That is what I wanted to make sure of, that you said the same thing.

A. After it was definitely decided in that litigation that the patent was invalid in the jurisdiction of that court, then we were through as far as paying any royalties under that license, until it is re-established again.

X24. Q. And you have paid nothing since?

A. We have paid nothing since.

X25. Q. Does this paper here express the whole of the agreement between R. & H. and all of its subsidiaries, on one hand, and this Dovan Company on the other?

A. That agreement, I think, refers to—Now, wait a minute. I would like to glance that contract over, if you please. (Contract handed to witness). Mr. Edmonds, at the time this contract was signed, our people agreed with Dovan that we would consent to the issuance of a license to Dovan by the Graselli Chemical Corporation, under a certain patent. We had the right at that time to say whether any more licenses should be issued, or not, and we gave our consent to the issuance of such a license. I think that is the only thing that you could say that was connected in any way with this agreement that does not appear in it.

X26. Q. Was that the subject of some other writing?

A. Well, it is in this sense,—that an agreement was executed between Dovan and Graselli, and we indicated in writing, either on that agreement or on a letter which accompanied that, that we gave our consent to it.

X27. Q. Did you have a written license from the Graselli Company under this other patent?

A. Yes.

X28. Q. And did that say that you were the exclusive licensee?

By Mr. Wooster:

I object to that, as outside the direct, and involving relations between the Roessler & Haslacher Chemical Company, or its subsidiary Perth Amboy Chemical Works, and Graselli Chemical Company which are entirely outside the issues of this case.

A. If I can answer your question in this way,—that under the terms of that license agreement Graselli would not have the right to issue a license to the Dovan Chemical Corporation unless we gave our consent.

X29. Q. That, I take it, means the same thing I said,—that you were the exclusive licensee.

A. No, it doesn't mean quite the same thing.

X30. Q. And the only thing supplemental to this is that at that same time you consented that the Dovan Company might be licensed under this other patent, owned by the Graselli Company.

A. Yes, that is the only other thing that I recall.

By Mr. Edmonds:

Well, I think this whole transaction should be made a matter of record, and therefore I call on the plaintiff to produce this license of the Dovan Company under this other patent, for inspection of counsel. If that is a thing that you do not care to have made public, I will agree to leave out any parts that you think you would like to have suppressed. I haven't anything further from this witness.

By the Court:

The purpose of this is just simply to show acquiescence by other companies in this patent?

By Mr. Edmonds:

Less than that, Your Honor. It is an acquiescence which occurred two or three years ago and stopped in the summer of 1923.

By the Court:

Well, I don't know that we are interested particularly, are we, in the absolute details of that.

By Mr. Edmonds:

I think it is a very trivial matter, but if part of it comes out, I think the whole thing ought to be on the record. I don't see that any of it was needed at all.

By the Court:

I can conceive it might be an element to show there had been a qualification in the acquiescence of the patent, and in that event it might possibly be admissible in evidence along a certain line, although, in the ordinary case, the fact that parties outside of the record had taken any particular attitude in the matter would be entirely irrelevant in a dispute between two parties.

By Mr. Kennedy:

That is true. But it is not applicable in a patent case. Patents are addressed, not to a court, or to lawyers, or to patent lawyers, but to those skilled in the art to which the patent per-

tains, and if one in that art takes a license under that patent to manufacture and sell, or use, and pays tribute, he recognizes the patent as a valid patent from his point of view.

By the Court:

I think that is probably true in regard to this, and I am inclined to admit testimony to that effect; but I don't see—and I am addressing myself to counsel on the other side and his objection to it—that we are especially concerned, or that we ought to encumber the record with anything else than the mere essential fact there, unless there is dispute of the fact, and it is alleged that the contract was something else than that general acceptance. If it were qualified in any way, or the agreement were something else, then I could conceive that that agreement ought to be offered in evidence; otherwise its only purpose—it would only serve to encumber the record. I think upon demand counsel is entitled to inspection of the agreement.

By Mr. Edmonds:

That is all I ask, and if on inspection I find it will not add anything, I certainly will not offer it. But when they bring in this transaction, I think I should be permitted to know what the whole transaction is, instead of just a part of it. I don't understand that any objection has been presented to my request—is there?

By Mr. Wooster:

Yes, I object to it.

By the Court:

If you offer testimony of the existence of an agreement, you are subject to all the demands which would naturally fall upon you, and part of it would be the production of the agreement, for the purpose of finding out. You are testifying here as to a conclusion. If there is no dispute as to the conclusion, the record ought to be allowed to go, as a matter of common sense, with that, as sufficient; but if there is any question as to the correctness of the conclusion, that must be determined by the production of the agreement.

By Mr. Wooster:

This agreement that is here produced between Perth Amboy and Dovan Chemical Corporation expresses the entire agreement between those two companies as to this patent in suit. The agreement now called for by Mr. Edmonds is an agreement between the Perth Amboy Chemical Works, the Dovan Chemical Corporation and the Graselli Chemical Company of Cleveland, respecting an earlier patent, owned by the Graselli Company.

By the Court:

But your inquiry related simply to the agreement between the Dovan Chemical Company and the company first mentioned?

By Mr. Wooster:

It did.

By the Court:

Well, I think your attitude is right then.

By Mr. Edmonds:

The answer to that is that this paper does not express the whole agreement that this Perth Amboy Chemical Works entered into. In addition to that, there is consent to the execution of another paper, which really amounts to giving up some right that they then had. They had the right of precluding the Graselli Company from licensing anybody, and they gave up that right to the extent of allowing the Graselli Company to license.

By the Witness:

It was a three-party agreement, Mr. Edmonds.

By Mr. Edmonds:

The Graselli Company,—your company, and the Dovan Company.

By the Witness:

Yes.

By Mr. Edmonds:

That is the paper I wish to see, as completing the transaction referred to here.

By the Court:

The effect of that is what, you claim—as modifying the recognition of this contract by the Perth Amboy Company?

By Mr. Edmonds:

Not knowing what it is, I can't very well characterize it, but it may be that this whole transaction is a fictitious one, and that the na-

ture of it would appear on examination of that document.

By the Court:

Well, I think that so far as examination of the agreement is concerned, you should be entitled to that in connection with the cross examination.

By Mr. Wooster:

It is not here. We can bring it next week. It is admitted to Your Honor—and I think you will agree that it is irrelevant here, and that if it has any effect at all it simply shows that Perth Amboy Company, in addition to paying money to the plaintiff here under the patent, paid a further consideration in permitting the Graselli Company to license Dovan.

By the Court:

Well, I think that would be immaterial, unless it were along that particular line, as possibly modifying the recognition, and showing that they had perhaps some other, in which event that might be shown, as affecting the main proposition of recognition. You may produce it next week, and in the meantime we will allow you, in case it is necessary, to reopen the case and recall the witness.

By Mr. Edmonds:

X31. Q. This license agreement that you have produced is a license not only under this patent in suit, which has been held to be invalid, but also is

under another Weiss patent relating to a process of manufacture of this substance known as D. P. G.?

A. That is correct.

X32. Q. And you operated under that other Weiss patent on that process of making D. P. G.?

A. Yes, we did at one time.

X33. You don't any more?—Well, if you would rather not state, I will not press that question. Now, it was represented to you that this other patent covered a process whereby this substance could be manufactured at a very low cost, and that is one of the reasons why you entered into this agreement, isn't it? Perhaps you may want to read the paragraph—

A. I recall the matter that you refer to. The cost that the Dovan people told us they could realize was stated in the contract. Whether those are very low or otherwise is a matter of opinion.

X34. Q. And furthermore you were licensed under certain Canadian patents by this same agreement?

A. Yes.

RE-DIRECT EXAMINATION.

By Mr. Wooster:

35. Q. In the event that Weiss patent, 1,411,231 in suit is upheld in litigation other than that in New York against the National Company, is your company obligated to resume payment of royalties for its sales of diphenylguanidine and disubstituted guandines, as accelerators for the vulcanization of rubber?

By Mr. Edmonds:

Is that covered by some statement in this paper?

By Mr. Wooster:

I am asking him the fact.

A. If the patent is re-established, yes.

By Mr. Edmonds:

36. Q. Is that covered by some provision in this document?

A. That is covered by an agreement that was executed after that.

37. Q. Oh, then there is some more to this agreement. You only mentioned one thing—

A. Well, Mr. Edmonds, that patent was superseded—

By Mr. Wooster:

That agreement.

A. —that agreement was superseded after the National decision a year or two ago by another agreement.

By Mr. Edmonds:

Well, then, I will call on my adversary to produce that agreement also.

By Mr. Wooster:

That is here and is produced.

38. Q. Now, in these two documents, and this three-party agreement that you have referred to, will we have the whole transaction?

A. I think so.

By Mr. Wooster:

I offer in evidence as Plaintiff's Exhibit No. 10, pages 2000 to 2074, inclusive, of the 2000 X-book.

It is stipulated that in lieu of the original book—which will remain here during the trial and argument, and be subject to production upon request, so far as plaintiff can thereafter obtain it from Republic Rubber Company, or Lee Tire & Rubber Company—photostatic copies of these pages may be substituted and used with the same force and effect.

By Mr. Edmonds:

It will certainly be produced in the Court of Appeals if this case ever gets there.

By Mr. Wooster:

If we can get it. I also offer page 1764 (previously marked Plaintiff's Exhibit No. 7); also page 1773 (previously marked Plaintiff's Exhibit No. 8); I also offer page 1777 (previously marked Plaintiff's Exhibit No. 9). The same stipulation is made as to production of this 1700 X-book and use of photostatic copies of these pages, as was made in the case of the 2000 X-book.

By Mr.Wooster:

I am reliably informed that since the service of process in this case on defendant, Corona Cord Tire Company, Messrs. E. I. du Pont de Nemours Company, of Wilmington, Delaware, have assumed the control and expense of the defense of this suit, and I request Mr. Edmonds to so state.

By Mr. Edmonds:

Mr. Edmonds refuses to make any such statement.

By Mr. Kennedy:

If your Honor please, if there is a party—an actual party and not a nominal party here in court in the defense of this suit, he is in the attitude of submitting himself to the jurisdiction of the court, as the courts have repeatedly held. If, therefore, the Du Pont Company has assumed control of the conduct and expense of the defense of this suit, the plaintiff is entitled to know it, because if it has, then it is estopped by any decree, if there be such, that may be entered in this suit for plaintiff and against defendant. On the other hand, if the decree should be otherwise, it would not be estopped but would have the benefit of it. Now, if counsel for defendant knows that the Du Pont Company is in the attitude stated by my associate, Mr. Wooster, as an officer of the Court he should say so.

By Mr. Edmonds:

It strikes me as being an absurd proposition, that this plaintiff—when it decided to bring suit, it could have brought suit against the Du Pont Company, or anybody they pleased, who they thought were infringing, and they chose this Corona Company, and we are here defending as to whether this Corona Company infringed this patent. That is the only issue before this court, and as to who may be aiding the Corona Company, or whether anybody is aiding it, has no more

bearing on the question of the validity of this patent than anything else one might imagine.

By the Court:

Yes, that is confirming my impression, that you cannot bind the other company. I will give the matter some consideration between now and next week, although I am free to say my present impression is very strong along that line, that you certainly cannot bind a party not intervening and not a party to the suit by any such loose method as that.

By Mr. Wooster:

I am prepared to call Mr. Doty and offer prima facie proof of that.

By the Court:

Well, you haven't them in court.

By Mr. Wooster:

Who—the Du Pont Company?

By the Court:

Yes. Unless they come in and formally intervene—if their counsel does not formally make such statement as that, and ask for leave to intervene, my impression is very strong that you could not do it. But as I say, I shall give the matter some consideration. I never heard of any such method of joining a party.

By Mr. Wooster:

Your Honor will appreciate from my statement that we filed this bill in good faith against the Corona Cord Tire Company, and thereafter,

I said, this Du Pont Company has taken control of the case. Now, I offer prima facie proof of that, if counsel will not admit it.

By Mr. Edmonds:

I certainly would object to any such proof of that, just as I would to all other irrelevant proof.

By the Court:

You may make your offer at this time.

HENRY S. DOTY, a witness produced on behalf of plaintiff, having been duly sworn, testifies as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation?

A. My name is Henry S. Doty; age, forty-one; residence, Passaic, New Jersey; occupation, president of the Dovan Chemical Corporation.

2. Q. Did you attend sessions of rebuttal testimony for Scott, in the interference of Scott vs. Weiss vs. Huser, which were referred to here yesterday?

A. Yes.

3. Q. Where was that?

A. The sessions were held in Boston and New York.

4. Q. I asked you about the rebuttal testimony for Scott. Where did you attend that?

A. In New York City.

5. Q. Where, whose office?

A. At the office of Prindle, Wright, Neal & Beam.

6. Q. Do you know James W. Kinsman?

A. Yes.

7. Q. Was he at any of these sessions?

A. Yes, he was at most of them.

8. Q. By what company is he employed?

A. The E. I. du Pont de Nemours Company.

9. Q. In what position?

A. I believe he is manager of the Intermediates Department.

10. Q. How long have you known Mr. Kinsman?

A. About a year.

11. Q. Did you and Mr. Kinsman have a conversation respecting this case here of Dovan vs. Corona Cord Tire Company?

A. Yes, we frequently mentioned it.

12. Q. When?

A. At these various meetings.

13. Q. What was said?

By Mr. Edmonds:

No, no—No general question, letting the witness answer anything he pleases. I think the questions must be made definite. We might just as well get to the issue at once. Why not ask him if Kinsman told him that du Pont was interested in this suit?

14. Q. Did you have any conversation with Mr. Kinsman as to who was controlling and defending this suit and paying the expenses of it?

A. Yes.

By Mr. Edmonds:

I object to this question, because it is irrelevant and immaterial, in that it has no bearing on the single issue before this court, which is whether or not a certain patent is a valid patent; and even if the subject matter words are named, it could not be proven in any such way as this.

By the Court:

I doubt if the agency even has been established. I will for the present sustain the objection.

Exception noted to plaintiff.

By Mr. Wooster:

I expected to prove by this witness that Mr. Kinsman definitely stated, without qualification of any kind, that the du Pont Company was controlling the defense of this case, and further expected to prove that Mr. Kinsman was authorized to make such statement, by reason of his responsible position with the du Pont Company, and that he had actual knowledge of that fact. This statement is made to preserve my exception.

By Mr. Edmonds:

In view of that statement, I would like to say that if these expectations were realized, I would prove that Mr. Kinsman was not authorized to make any such statement.

By the Court:

I will sustain the objection.

By Mr. Wooster:

Subject to the objections and exceptions taken as to further proof by plaintiff, prima facie proofs are closed.

(PLAINTIFF RESTS).

DEFENDANT'S CASE.

By Mr. Edmonds:

As stated by Mr. Kennedy, the patent involved in this suit has been in litigation heretofore, in the Second Circuit, and has been found to be a valid patent. The suggestion that four Circuit Judges passed on that patent and were equally divided numerically, is true in a very superficial respect. The opinion of Judge Manton, which doubtless will be submitted here, involves errors of fact and errors of deduction from facts, and in the opinion in the Circuit Court of Appeals, of Judges Hough and Rodgers, there is an accurate statement of these facts, at the bottom of which is a notation that Judge Mayer dissents. There is no suggestion anywhere that Judge Mayer concurred in anything that appears in Judge Manton's opinion, so that the idea that two judges concurred in some view favorable to the patent, and two were opposed to it, is quite wide of the fact. Unless your Honor has seen the opinion of the Circuit Court of Appeals, perhaps you would care to have me pass those up. It is reported in 292 Fed. Rep. As I stated, the opinion of the District Court is not reported.

The patent involved in this suit relates to accelerators in the process of vulcanizing rubber. This process of vulcanization used in practically all rubber articles, is a process of uniting sulphur with the rubber to improve the physical properties of rubber, and make it harder or more elastic or stronger, or whatever particular physical properties are desired. Those properties are arrived at by vulcanization, and that has always been the process of vulcanization throughout the eighty years that has been employed. For many years past, much more than Mr. Kennedy suggested, probably for all of eighty years of vulcanization, accelerators have been used to hasten the process of vulcanization. At first, the substances used were what chemists knew as inorganic substances. In more recent times, organic substances were found to be better, and they have been used over more than ten years back, and chemists have steadily investigated to produce better and better. The patent in suit purports to disclose a particular one, which is stated to be better than any others. There is in this patent one single idea, and nothing else, namely, that one particular substance that is named there is a very active accelerator, a more potent accelerator, than substances that had been known before. That is the sole idea of this patent as involving any novelty. The claim is that this man found that this one substance is a more active accelerator, and when one has said that, he has stated all that is suggested in this patent as involving any novelty. That substance is this one named

diphenylguanidine, a substance that has been known in chemistry for generations back, is listed in chemical literature, its formula given, and all that sort of thing, but no utility in the industrial world for that substance had been known, and the claim of this patent is that this patentee had found that particular substance, known for generations, but not known to have a special utility, is a powerful thing in accelerating the vulcanization of rubber. That is what this patent purports to cover. At this point I would like to say that Your Honor may feel, unless you have had occasion to study the chemical sciences, that this suit is going to present several difficulties from a scientific standpoint. I think that is not so. I say that from my own experience. The properties of chemistry involved are simple to a degree, and will require nothing more than acceptance of the statement that certain substances will accelerate vulcanization. Why they do it, and how they do it, Your Honor need not know for the purposes of this case, and it is well that we need not. The leaders of thought in the chemistry of rubber are much disagreed as to that, even to the present day, and they have been trying to come to some decision as to how these chemicals act. For our purposes, all we need to know is that if you put a certain quantity of one of these substances into the rubber batch, acceleration will occur.

Now, if I have pointed out to Your Honor exactly what it is that this patent purports to disclose to the world, as to the item of novelty, I

want to proceed to the defenses which we shall undertake to present.

First of all, there is this very remarkable circumstance, at a time more than two years before the application for this patent was filed in the Patent Office, a man of recognized standing in the rubber industry, known far and wide as one of the leaders of thought in the chemistry of rubber, addressed a meeting of representative rubber chemists of the country, at a meeting of the American Chemical Society in Philadelphia, and in the course of his address he disclosed to these chemists assembled there the very thing that this patent purports to cover, and more than two years before the patent was even applied for. He did it orally, standing up before a meeting of these chemists. For that reason, that disclosure, made more than two years before the application for patent was filed, is said by the plaintiff not to be a statutory bar to the validity of this patent, because the statute says that only a disclosure in a printed publication will suffice as a statutory bar. The fact of the matter is, that this paper read there by Dr. Kratz was not in print, and was not circulated among these men until a few months later, within the period of two years before the application for the patent was filed.

Now, there is this further most unusual circumstance, to which I think great weight must be given, and which we should certainly establish here, namely, that when this Dr. Kratz made this disclosure to this meeting of chemists in 1919, more than two years before the application was

filed, what he said and what he imparted to these assembled chemists by reading that paper, and also by putting certain tables on a blackboard, was within a very few days of the application for the patent in suit, and he knew of that disclosure throughout this period of over two years, during which he deferred the filing of the application for this patent, and during which he deferred the assertion of any claim whatever to having originated this idea. More than that, we will show that during that period of two years, within which he made no claim whatever to having originated this idea, there were occasions when there was every reason in the world why he should have asserted that claim, and why he doubtless would have asserted it, if there had been any truth in it.

We shall show further that Dr. Kratz, who read this paper before the meeting I have referred to, not only conducted the laboratory investigations necessary to develop this information that he put into the paper, but also that he made use of that information in a shipment of automobile tire tubes that were made at his plant, and that those tubes which he made, and which had this substance in them, constituted a utilization of the invention at a time prior to any claim by the patentee, and that the patent is therefore invalid, by reason of what is known as a public use.

So with respect to this work of Dr. Kratz's, we say that the patent in suit is invalid, because of prior knowledge by Dr. Kratz, long prior to anything claimed by the patentee, and acknowl-

edged by those who operated with him in the laboratory where he was working; second, that it is invalid because of the manufacture and sale of these tubes that I referred to, having the substance in them, and of course prior invention by Dr. Kratz, because if there is any invention in this substitute at all, it was made by Dr. Kratz before it was made by Weiss.

Those are three defenses that we shall present. Also, I shall continue to assert, as I always have asserted, that even if this idea had originated with this man Weiss, and no one ever set up an adverse claim, still the thing does not involve invention. The patent should be held to be invalid, as not covering an inventive idea. This patent, I say, is granted for a thing that should have been obvious to any man skilled in the art, to such an extent that the patent should be held invalid for that reason.

To elaborate that just to a small extent, I might say that in the very factory were this man Weiss was working, they were making use of a substance known as triphenylguanidine, which is as closely related to this diphenylguanidine as the names would seem to indicate. In the dictionary, the two come immediately one after the other. Anybody working with triphenylguanidine and having any occasion to look into a dictionary, as the chemists in the plant doubtless would, would have found on the next line this substance diphenylguanidine, and all he had to do was to try it. That is the only way any accelerator is ever found, because there is no way of foretelling what

will be an accelerator. No one knows just why it accelerates and how it acts. Moreover, the literature of the rubber art had contained references to the guanidines as possible accelerators, and that suggestion of the guanidines as a class, coupled with the actual use of triphenylguanidine, seems to me to make the mere act of taking the next thing in the dictionary, and trying that and finding that that is an accelerator also, just what one would expect it to be who knew that triphenylguanidine was an accelerator. That is not an inventive act.

Such a patent is what Judge Hough referred to in that decision as a patent of observation. He did not say that the patent was invalid because it did not cover invention. The Court of Appeals held the patent invalid, because of this work of Dr. Kratz. They said the idea was disclosed in a book, in Dr. Kratz's paper, and that the plaintiff had failed to prove the date of the invention of Weiss earlier than that publication. They said further that even if you grant all that the plaintiff offered by way of proving the date of invention of Weiss prior to this paper, then by the same token you must look into Kratz's work, and you will find that at every step of the way Kratz was ahead of Weiss, ahead as much and more than Weiss.

It was on that ground that the patent was held to be invalid by the Court of Appeals, and the Court did comment on this other defense which is present; that is, that the act said to be an invention was not an inventive act at all, and

in commenting on it, Judge Hough dubbed the patent a patent of observation, a patent granted to a man for observation of a thing that anybody might have observed, and that the suggestion looked for was contained in what the art had known before.

In addition to that, there is one further defense which we shall present, and that is that this idea, this one idea of the Weiss patent, did not originate with Weiss. There is a peculiar situation in that connection which can hardly be outlined briefly, but as briefly as I may state it, I will say that in the Weiss effort to establish that he conceived this idea before this Kratz paper, it became necessary for him to present the records of the laboratory where he worked in 1918 and 1919—this Kratz paper was in September, 1919—and he presented this laboratory book of the Republic Rubber Company, and referred to certain experiments recorded therein, and that book discloses that Weiss's predecessor in that laboratory had experimented with diphenylguanidine, one of his experiments recorded there, and curiously enough, on the same page Weiss came along some eight or ten months later and recorded another experiment right there. So that the suggestion of this was not an original suggestion of his. It was a suggestion made to him by this record of his predecessor's work. He of course denies that he saw that, and he said he had no recollection of it. Once or twice I think he said he didn't see it, and at another

time said it was not there. I think he said various things about it.

We will maintain that that record was there all the time that Weiss was working in that laboratory, recording experiments in that book, and the suggestion of the one item of novelty that appears in this patent came from the records that he saw there, not as an original suggestion of his own.

Those are our defenses as to all the claims of this patent, but I wish to say further that there is one group of claims which the plaintiff asserts has a wider application than merely to this one substance, diphenylguanidine. In those particular claims, they attempt to employ a broader definition, by characterizing the achievement of one involving the use of disubstituted guanidines, which they say is this diphenylguanidine and various others. As to those particular claims, there are additional defenses applicable only to them. One of them is that there is a magazine article published more than two years before the application for the patent was filed, which discloses a disubstituted guanidine usable as an accelerator. That is not diphenylguanidine, and therefore that publication would not be a bar to the validity of these more narrowly related claims; but as to these broader ones, that publication alone, we say, is a complete bar to the validity of those claims. This is a matter which was presented in the Aniline suit, which was not referred to by the Court of Appeals, because all the claims were held to be invalid.

One other defense applicable only to these broader claims is that they are improper claims, for the reason that they attempt to cover many things other than those that this patentee had any knowledge of, and by doing so, they make the invention broad enough to cover substances that would not be accelerators at all, and the claim is necessarily bad, for the reason that attempted broadening of the definition was carried so far as to include things that are not accelerators at all, and the claim is bad for that reason.

I think that that covers the defenses on which we rely.

Perhaps it would be well for me to speak briefly of one other subject. The proceedings in the Patent Office that led up to the granting of this patent are rather important, and we think they are of outstanding importance. As I said, this patentee claims to have made this invention in the early part of 1919, but his application for the patent in suit was never filed. He never applied to the Patent Office for a patent until November, 1921. He waited over three and a half years. Now, when he did apply, the Patent Office Examiner made the usual search among disclosures of accelerators, to see if its application presented anything new, and he found a magazine article written by Scott and Bedford, two well-known rubber chemists, in which they referred to this substance, diphenylguanidine, as an accelerator. Now, that would have been a valid basis for rejecting this application, but for the fact that the date of that publication of Scott

and Bedford was some time in 1920, and Weiss made the claim that he had made the invention before that publication. Now, in accordance with Patent Office procedure, that claim of an early date, to overcome a rejection of that sort, must be made by affidavit setting forth the actual date of invention. So Weiss, with some of his associates, submitted an affidavit in reply to that rejection, in which they attempted to recite the facts that would justify them, and assuming that he made the invention prior to the Scott and Bedford paper. Those affidavits were submitted, and the Patent Office Examiner withdrew his rejection and allowed the application.

Now, before the patent was issued on the application, this paper of Dr. Kratz came to the attention of the Examiner. As I said, it was delivered orally, more than two years before the application for the patent was filed, but the paper appeared in print some six months later. One of the magazines printed it in full in April of 1920, which you see is a year and a half before the application for the patent was filed. Now, the paper came to the Examiner's attention, the attention of the Patent Office examiner passing on this Weiss application, and he recognized at once that in this Kratz paper was the statement that this diphenylguanidine was an active accelerator, much more active than triphenylguanidine, and various others; in fact, the paper goes so far as to give the parts representing the exact ratios of activity of these substances. And the examiner then applied to the Commissioner

to have that application that he had allowed, sent back to him, and when he got it sent back to him he rejected the claims again. In view of this Kratz publication, to which he referred as having been printed in this magazine of April or March of 1920, and he said "This purports to be a paper delivered orally in September, 1919. So that is the effective date." Now, in answer to that rejection, Weiss and his cohorts came back with another series of affidavits, in which they attempted to establish that the invention was conceived and developed, etc., by Weiss at a time prior to September, 1919, considerably more than two years before his application for patent was filed. Now, as your Honor will appreciate, the Patent Office has no machinery to examine into the facts submitted by affidavit, so that when this affidavit seemed superficially to establish a sufficient early date there is nothing that the Patent Office can do but accept them and allow the application and issue the patent, and that is what this examiner did. Those affidavits we shall have considerable occasion to refer to because, in our estimation, it appears now in the light of facts that have subsequently come out, that they were gross misrepresentations and that the patent was issued on the basis of such misrepresentations. I think this is enough to inform your Honor as to how the patent came to be issued by the Patent Office, in view of these prior publications of the greater activity of diphenylguanidine.

I wish to say further that this story of Weiss

that he made this invention away back three or four years prior to the filing of his application, has now been told I think five times; first, in the first series of affidavits, and second, in the second affidavits, filed in the Patent Office, and third in the suit that was tried in New York, where Weiss took the stand; and fourth, in the course of the interference proceeding involving another application for patent filed by Weiss on a somewhat different subject. Those four times, and I suppose we have to hear it again.

One further thing that I should mention, to cover the subject and all its elements, is this: As I said at the outset, this substance, diphenylguanidine, has been known for generations. It appears in the chemical text books, and directions for making it are readily available, but there not being a known use for it. There had been enough in chemical rubber developed for the manufacture of it, so that if in 1917 or 1918 some one had wanted to sell diphenylguanidine and had looked it up in the dictionaries that the literature afforded, he would have found that the cost of producing it by that laboratory method would be considerably in excess of the price which rubber companies would pay for accelerators. So in order for that substance to be used as an accelerator, it must be very obvious that two things were essential; first, that the utility of the substance must be appreciated, and second, that the substance must be manufactured at a cost that is within the reach of commercial possibilities, a

price that the rubber manufacturing companies will pay.

In addition to the patent involved in this suit, Weiss has taken out another patent, which covers a process of making diphenylguanidine. That process, and nothing else, a series of steps involving chemical reactions, etc., that must be taken to produce the substance, and in that patent he says "Prior to my invention, this substance has been known but there has been no known method of making it at a low price, and my object is, as disclosed in this patent, to develop a process whereby this material can be made cheaply". Now, it may be that he did devise a process, and it may be that process itself involved invention, and he certainly has a patent on it. That is an unquestionable fact. But I mention this because I hope it will be possible to keep these two patents entirely distinct and separate in the course of this suit. They are two wholly different things, for two different ideas, put forward by Weiss as being two different ideas, susceptible of being patented separately, and recognized by the Patent Office as two separate and distinct achievements, and I say that because one of the most serious errors that Judge Manton made was to consider these two patents together, as though they were one only, and covered one achievement, and he thought that Weiss must have done something, so he sustained the patent covering the use of diphenylguanidine itself, on the basis of some achievement in devising a process for making it. That probably was due to the persistent

reiteration of counsel who then represented this plaintiff, who said an innumerable number of times that it was Weiss who made this substance available to the public. Suppose he did devise a process for making it at a low price? That has nothing to do with the disclosure of a single item of information that this substance is an accelerator.

DEFENDANT'S TESTIMONY.

By Mr. Edmonds:

There are some formalities for the defendant that probably should be taken care of at this time, but as there are two or three witnesses that we would like very much to examine today, so that they might go home, I would like to proceed with them at once, and if I may waive these formalities for the present, I would like to call Dr. Amend.

OTTO PAUL AMEND, a witness produced on behalf of the defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Barrows:

1. Q. What is your occupation, doctor?

A. I am president of Eimer & Amend.

2. Q. What is the business of Eimer & Amend?

A. The business of wholesale drugs, chemicals and chemical apparatus.

3. Q. Located where?

A. Located 18th and 19th Streets, and 3rd Avenue, New York.

4. Q. How long have you been associated with Eimer & Amend?

A. Since the fall of 1880.

5. Q. And what has been the business of Eimer & Amend since 1880?

A. Supplying schools, colleges, the various U. S. institutions in Washington, with chemicals and apparatus.

6. Q. How many chemicals does Eimer & Amend have in its list of chemicals that it supplies?

A. Well, I should judge about two thousand chemicals that could be called for every day—more or less ordinary chemicals.

7. Q. And what proportion of those are organic chemicals?

A. I should think about one to ten, that is, nine parts of inorganic to one part of organic.

8. Q. And how many organic compounds would you say you have in stock?

A. Well, it is difficult to tell. I judge about five to six hundred of the more ordinary chemicals, organic.

9. Q. And in addition, others which are not ordinary?

A. Which are not ordinary.

10. Q. How many of those?

A. I don't know how many. We have quite a list.

11. Q. Do you recall whether, prior to the time this country became involved in the World War, you had any guanidine derivatives in stock?

A. We did have, yes.

12. Q. Do you recall what some of those were?

A. Well, we were not able to import the organic compounds from Europe when the war started on the other side, and it was early in 1917 that the head of the so-called Pure Chemical Department sent up the questionnaire, asking whether we could give them the phenylguanidine group. I asked what they wanted, and they said they would like to have mono—, di— and tri— phenylguanidine.

13. Q. Did you have those in stock at that time?

A. We had the di— and the triphenyl in stock, and we were running low; and consequently they asked whether we would be able to produce them in our laboratories.

14. Q. How long had you had those in stock?

A. The triphenyl I was told we had in stock since 1914; the diphenyl, as far as my recollection goes, we had in stock since '16.

15. Q. Do you recall whether you had requests for these guanidine derivatives?

A. We must have had requests, because they said the stock was running low, and they wanted to know whether we could make some of it.

16. Q. Have you any way of knowing from whom these requests came?

A. I don't know, no.

17. Q. How many requests for chemicals of this kind do you have in the course of your duty?

A. Practically every day something is asked for that is not in the market.

18. Q. How closely are you identified in the af-

fairs of your company with these requests for chemicals?

A. I go through the mail in the morning.

19. Q. How extensive is that mail?

A. The mail runs between twelve and sixteen hundred letters.

20. Q. A day?

A. I beg your pardon—A day. In the morning, the first mail.

21. Q. Do you recall whether the Republic Rubber Company is or has been a customer of Eimer & Amend?

A. They have been a customer, yes.

22. Q. For how long?

A. I don't know, but quite some time back.

23. Q. Many years.

A. Yes, quite a number of years.

24. Q. Have you looked for any correspondence or orders or other records that would identify any purchases by the Republic Rubber Company from you, in 1916 or 1917?

A. I tried to look up some of the books, sales, etc., and I was told we kept the books, sales, etc., not longer than six years, because they accumulated, and we sold them as old paper.

25. Q. You mean, you haven't any records?

A. No, we haven't any records. Every six years we sell all the old books, papers and orders and everything else to a paper man.

CROSS-EXAMINATION.

By Mr. Wooster:

X26. Q. Is it the custom of your firm from time to time to publish a list of rare and stock chemicals?

A. Only the stock chemicals. We have now on hand large cases of chemicals that we put up in Newark that have not been called for, or else found too expensive. People very often order, and when they find out how much they cost they don't call for them.

X27. Q. Did you ever publish any list containing any of the substances as mentioned in your direct testimony?

A. No, sir. Those substances were ordered to be made by us—for us. We were the agents of Kahlbaum—C. F. Kahlbaum, of Berlin, who made most of the organic preparations for us.

X28. Q. So that any of these materials mentioned by you which you had in stock were obtained by you from Kahlbaum?

A. On special order, yes, made for us.

X29. Q. Did he publish lists containing his products?

A. No. Kahlbaum is just now making six chemicals for us that are not in his list and never will be.

X30.Q. Does Kahlbaum publish any list?

A. Yes, an ordinary list for colleges.

X31. Q. Did he publish a list at the time you mentioned?

A. He did.

X32. Q. How many different items do you suppose you have sold Republic Rubber Company?

A. I haven't the faintest idea. I am not in that department.

X33. Q. Over what period of years have you sold Republic?

A. I know I saw the name in the correspondence, as far as my memory reaches, back to 1914—'13—'14—something like that.

34X. Q. When did you last see the correspondence?

A. I dont remember.

X35.Q. I mean the correspondence which showed that these guanidine materials were mentioned—when did you last see that?

A. I don't remember. In fact, I don't know whether I saw any.

X36. Q. You mean, you don't know now whether you ever saw any correspondence or order calling for a guanidine or guanidine derivative?

A. I don't remember, for the simple reason that people sometimes come in and fetch an order during the course of the day, and the order is charged if they have an account, and those orders I don't see. It is only the first mail in the morning that I see.

X37. Q. Were you president of the company in 1917 and subsequently?

A. No, I was vice president.

X38 Q. And you read all these twelve hundred letters every day?

A. No, sir. They were picked out. The extraordinary things were always brought to me,—if any

questions came up, as to whether we could deliver stuff, whether we could make it, or ship it.

X39. Q. But you threw away ordinary as well as extraordinary matters after six years?

A. Always do. We have to. It is enormous, and we can't carry it.

X40. Q. Are you sure it is not three years?

A. No, it is six years. We put them away every six years, and have been doing it right straight along.

X41. Q. Do you know the chemical structure of guanidine?

A. I should say so. I know the old structure. when I studied in Wurzburg.

X42. Q. And the structure of the other materials mentioned?

A. The mono—

X43. Q. Yes.

A. Or what?

X44. Q. Monophenylguanidine?

A. No, I never knew that. I never paid any attention to that. I simply was asked whether we could make it.

By Mr. Barrows:

X45. Q. Doctor, you are a chemist?

A. Yes, sir, I am a School of Mines man, '79, and then finished my course in Germany.

X46. Q. And you have studied organic chemistry?

A. I did.

X47. Q. And you have been working in chemical work ever since?

A. I have been doing research work.

ABRAHAM BRILL, a witness called on behalf of the defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Edmonds:

1. Q. Mr. Brill, will you state your present residence?

A. Los Angeles, California.

2. Q. And your present employment?

A. I am not at present employed.

3. Q. Until quite recently you were employed with what company?

A. Sampson Tire & Rubber Corporation, Los Angeles, California.

4. Q. And what years were you there, and where were you employed prior to that?

A. I was there from 1924 up until September, 1925. Prior to that, I was with the Brunswick Balke & Collender Company, Muskegon, Michigan, where I went in 1917.

5. Q. And prior to 1917?

A. Prior to that, I was with the Republic Rubber Company, of Youngstown, Ohio.

6. Q. You are a graduate chemist?

A. I am.

7. Q. When and where did you graduate?

A. Carnegie Institute of Technology, 1910.

8. Q. And in these three companies that you have named, what was your capacity?

A. I joined the Republic Rubber Company as chemist, at the time I left I was chief chemist in

charge of the development. I went to the Brunswick, Balke & Collender Company as superintendent of the tire and rubber departments. When I left them I went with the Sampson Tire & Rubber Corporation as production superintendent.

9. Q. Now, at the Republic Company—First, fix the time as well as you can when you went with the Republic Company?

A. September, 1910, to June, 1917.

10. Q. Now, during the last two or three years you were in that employment, was the company making use of accelerators in its rubber products?

A. Yes.

11. Q. State what some of the accelerators were.

A. The first accelerator we used and developed was thiocarbanilid, which we used from some time in 1911 or '12 up until the time I left. Later on, we made use of hexamethylenetetramine, and some paranitrosodimethylanilin.

12. Q. Were these accelerators entirely satisfactory to you and your associates in your management of the Republic Company?

A. They were not, in every respect.

13. Q. Well, what, if anything, did you do toward finding something more satisfactory?

A. When we first obtained knowledge of the use of organic materials as accelerators, we developed this material which we subsequently found was thiocarbanilid, which we called Cromite. This was a thoroughly satisfactory material, but we realized there must be other materials which would go further and do the work required of this class of materials in a more satisfactory manner, and to that end I devoted

a considerable portion of my time. I tried a great number of substances and studied the nature very carefully with that in view.

By Mr. Wooster:

Just a moment. There is no public use or prior knowledge pleaded in this case, by Mr. Brill, or by Republic Rubber Company, and this looks like a preparation for it. I object.

By Mr. Edmonds:

Well, of course if we have not pleaded it we are not entitled to prove it, but the assumption that this is an effort to prove a prior use by the Republic Company, and therefore something we have not pleaded, is entirely an assumption without foundation. Does that answer your objection?

By the Court:

Well, we have not reached any stage, as I take it, where we can tell exactly what they are going to prove. There is no offer made. Does counsel desire one as to the proof?

By Mr. Wooster:

I simply want to reserve my objections. I don't understand what this is, and as I stated, he has not pleaded any prior knowledge by this witness or by the Republic Rubber Company as a company, and I do not want to permit it all to get in before I make my objection.

By Mr. Edmonds:

I consent to have the objection reserved, if the objection is to proving prior use by the Republic Company. I am not going to try to prove it. I am not going to try to prove anything that is not pleaded in the answer, for fear somebody might call attention to the fact that it is not pleaded in the answer.

By the Court:

Well, go ahead and we will find out what this is.

By Mr. Edmonds:

I have no objection to stating—

By the Court:

Well, there hasn't been any request for it. You may proceed.

By Mr. Edmonds:

14. Q. Were there any chemists in the employ of the Republic Rubber Company under your supervision in this period that you are speaking of, while you were bending your efforts toward finding some more serviceable accelerators?

A. During the early part of this period, I myself did most of the work, and I think possibly all of the work in connection with finding and trying of various organic substances which might be used as accelerators. During the summer of 1916, there was a change in the organization of the Republic Rubber Company, and I was put in charge of the laboratory and development department. This meant that I

would not be able to devote very much of my time to this particular work, and we had done enough along this line to realize that it was a very fertile field for further investigation, and upon talking it over with Mr. Clark, and possibly some of the other members of the organization, we decided to get a man to work along this line and devote his attention almost entirely to it.

15. Q. And this man you decided to get was to be hired for some purpose other than the usual one in the course of hiring other chemists?

A. Yes. He was hired with the particular end in view that the would devote his time almost entirely to this kind of work.

16. Q. State specifically what kind of work?

A. The trial of various organic materials in rubber compounds, with the idea of finding a rubber accelerator, which was more satisfactory than the ones which we were using at that time, or that we knew about at that time.

17. Q. State whether or not you had in mind any particular organic chemicals that you wanted him to examine?

A. We had nothing—no one definite substance in mind. I had done a lot of work on various materials and had read literature, which was more or less extensive in 1916, and one or two articles that I recall particularly summed up the various classes of accelerators into groups, and it was our idea to go right down the list and try members of the various groups. I recall particularly that I had myself tried urea, and among the substances or classes mentioned

in this paper were the guanidines, and I recall that I had tried to obtain representative members of this class, but I don't recall that I ever was able to get any. As I recall the matter, I was unable—It was not feasible for me to make any of these guanidines by the methods described in the literature that we had in our own library, and I don't recall ever going any further with making them. Neither do I recall ever having been able to get any through the chemical supply houses.

18. Q. Why was it not feasible to make them, if you can state briefly?

A. As I recall, the method given in the text-books we had called for some reagents that were rather difficult to handle, and that we had no way of preparing, and they were matters that in the press of other work we let drop.

19. Q. So this plan was developed for the purpose of trying these substances?

A. Yes.

20. Q. Who participated in the development of that plan—yourself and who?

A. Myself, with Mr. Clark,—there might have been Mr. Brown, or Mr. Peterson might have been there, but I don't recollect. But I do know I talked to Mr. Clark.

21. Q. And you two, or such others as joined with you, decided you would hire a chemist for this special purpose?

A. We did.

22. Q. What was done then?

A. We got hold of Mr. Baldwin, who was a

graduate chemist, and who had had some experience, and it was our idea to gradually educate him into the use of what organic materials we knew of at that time, and try what other materials had occurred to us that we might try and we had not had time to try, and work him into this line of work, so he could work on his own hook.

23. Q. So you hired Baldwin?

A. We did.

24. Q. Will you state when, if you can with any accuracy?

A. As near as I can recall it, it was some time in the middle of 1916.

25. Q. So Baldwin came there to the Republic plant at Youngstown and started in on this work you have outlined?

A. He did.

26. Q. Was he instructed as to what substances he should try, or was that left to him?

A. When he started in this accelerator work, I myself told him what was known—what I knew of what was known in the art, and I gave him what literature I had, and referred him to such books as I knew of that would acquaint him with what had been done. I also told him what I had done, in a brief way, so that he could start thinking on the subject and know what to do, what the general trend of his job would be.

27. Q. Beyond that did you have anything to do with the selection of the particular substances that he tried?

A. I think at first I did direct more or less his

efforts, by telling him what my ideas were and what I had done, and what I thought was very promising from my own experience and from the literature on the subject.

28. Q. Do you remember any particular books that you consulted in that connection?

A. Yes. We had a copy of Richter that I recall very clearly.

29. Q. You went through Richter and picked out such substances—

A. Yes, I went through that book many times before Baldwin came, and I may have gone through it with Baldwin; I am not sure.

30. Q. Now, these substances that you picked out and wanted to try, what did you do about them?

A. In the ordinary course of events, we would make out a list with a requisition, which would be sent to our Purchasing Department, for purchase.

31. Q. Do you personally recall any contracts with the purchasing agents in this connection?

A. Yes.

32. Q. Any circumstances in that connection that are recalled to your mind?

A. I recall that in many cases we got some rather sarcastic remarks thrown back at first, at some of the materials we ordered. After they had received prices on them, they wanted to know whether we were buying goldleaf, and remarks of that kind.

33. Q. Now, what did Baldwin do, in accordance with these instructions that he got from you?

A. Well, Baldwin, eventually after he came with the company, started compounding with various or-

ganic chemicals and recording—testing and recording the results.

34. Q. Do you recall any work of Baldwin in connection with D. P. G.?

A. I do not.

35. Q. What was the practice in the Republic Company with respect to keeping records of experiments that were made in the chemical laboratory?

A. When a new man was put on experimental work as regards compounding, he was given what we call an X-book, which he used himself, and in which were to be recorded all experimental compounding that he might do. When I presented this book to the new man, I always was very careful to impress upon him the importance of keeping complete records, giving the date and the result of the tests, whether they were satisfactory or unsatisfactory.

36. Q. Had you yourself observed this practice that you instructed others to observe?

A. I tried to as well as I could, yes.

37. Q. So among the records of the Republic Company you would expect to find an X-book with your experiments recorded in it?

A. Yes.

38. Q. Now, what about Baldwin—was he instructed to keep such records?

A. Yes, Baldwin was so instructed.

39. Q. Do you know whether you instructed him?

A. I did—I will amend that. I will say that—I don't recall instructing Baldwin, but I know that I would have, in the ordinary course of events.

40. Q. Now, you recognize this 2000 X-book of the Republic Company as a book of the character you have referred to?

A. Yes.

41. Q. Can you say whether or not any of the experiments recorded on the first six or eight pages of this book were made by Baldwin?

By Mr. Wooster:

I object to that secondary and incompetent.

A. I wouldn't want to say definitely. I do recall that Baldwin's writing was peculiar, and it might be that was Baldwin's.—I wouldn't want to say that was Baldwin's. I remember his printing is very irregular and not artistic, I do recall that.

42. Q. I call your attention to the fact that in the first column of the page which is numbered X-2005, there is a record of an experiment, in which one part of D. P. G. is shown to have been used. Do you have any recollection in connection with this?

A. No, I do not.

43. Q. So that, understanding that you do not recall that particular experiment, will you please state whether or not that experiment was in the line of what you hired Baldwin to do, and what you instructed him to do?

By Mr. Wooster:

I object. That is wholly incompetent and secondary, and merely calling for the witnesses's conclusion.

By the Court:

I think that is correct, Mr. Edmonds, in a large part, because he has presumably fully detailed the purposes of the employment of Baldwin, in the instructions given him.

By Mr. Edmonds:

I think he can give a little further testimony that will be of assistance. I recognize the fact that it is not the best testimony, because I myself have brought out the fact he does not remember this particular experiment, but this is by way of introduction to the testimony of Baldwin, which is to follow immediately.

By the Court:

Of course this question is simply whether it it along the line of the instructions he has previously detailed, and I presume the record speaks for itself in that respect, in connection with his previous testimony. Is there any question as to that—that is, that the record itself requires explanation, or is it sufficient on its face to show what it is?

By Mr. Edmonds:

If Your Honor please, this entry here of the test with D. P. G. is stated by the plaintiff to be a record which was not in that book at the time when Weiss came along and wrote some other things on the same page, and we propose to prove that it was there, and that is the purpose of this testimony.

By the Court:

Then in connection with that, you simply show the facts you have shown,—there is no question as to the relevancy of such proof as that, but in connection with that he is called upon to state, as a matter of conclusion, what is, as I think, covered by his previous testimony and by the record itself, if offered in evidence. In other words, he has already testified as to his instructions and the general work of Baldwin pursuant to those instructions. Now, wouldn't the offer of the sheet itself answer the question which you have asked him, that is, whether that experiment was along the line of his employment and his instructions given pursuant to his employment?

By Mr. Edmonds:

Possibly so, as a matter of argument, but I should think it would be better and I would prefer to have it in as a matter of direct statement by the witness.

By the Court:

Well, we will allow it to go in and overrule the objection.

Exception noted to plaintiff.

(Question read.)

A. As I go over it in my mind the work we had done prior to this time in the laboratory, as regards developing of organic accelerators, and particularly some of these classes as given in these various articles, I would say that it would be very peculiar if,

in going over this book, I did not find some work by Baldwin, in which he had tried these different guanidines. D. P. G. would be one of them.

44. Q. Will you state whether or not you have any recollection of discussing D. P. G. with Mr. Baldwin?

A. I wouldn't say that I did or did not. I know I discussed a number of substances, and that might have been among them. I don't recall. I will say, though, that I did discuss the guanidines, which was one of the classes mentioned in this particular article that I refer to.

(No cross examination.)

RALPH W. BALDWIN, a witness called on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. State your present residence, Mr. Baldwin?

A. Wilmington, Delaware.

2. Q. And your present business connection?

A. Manager of the New Way Laundry Company.

3. Q. Until recently you have been in some other line of business, have you not?

A. I didn't get the question.

4. Q. Until quite recently you were in some other line of business?

A. Up until this year I have always been in the rubber business, rubber manufacture.

5. Q. And with what company were you last employed?

A. With the E. H. Clapp Rubber Company, of Boston.

6. Q. And prior to that, with what company?

A. With the Pioneer Rubber Company.

7. Q. Well, you were at one time in the employ of the Republic Rubber Company at Youngstown, were you not?

A. Yes, sir.

8. Q. Between what years were you employed there?—Give the exact dates as well as you can.

A. I went with the Republic Rubber in the summer of 1916, and left there in the spring of 1918.

9. Q. In what capacity were you working with the Republic Company?

A. I went with the Republic as a chemist in 1916, to do special work under the direction of Mr. Brill, and later I was in charge of the Chemical laboratory, and then during the war I did factory control work.

10. Q. When you first went there, who was your immediate superior?

A. Mr. Brill.

11. Q. Your instructions came from him?

A. Yes, sir.

12. Q. Did he give you any instructions with reference to recording any experiments made by you?

A. He did.

13. Q. What did he tell you to do?

A. To always record experiments done by me in the X-book.

14. Q. A book of the character of the book in front of you there?

A. Yes, sir.

15. Q. He gave you one of those books and told you to record everything in that?

A. Yes.

16. Q. What was to be the general nature of the chemical work that you were to do when you entered the employ of the Republic Company?

A. Why, it was mostly special work that Mr. Brill outlined—especially with reference to organic accelerators, in which they were at that time very much interested.

17. Q. And what did that work on organic accelerators involve—I mean the actual work that you did?

A. Why, the preparation and trying out of different organic accelerators, that we could either make in the laboratory there or procure in the open market.

18. Q. And did you make some such preparations?

A. I don't think we made any strictly organic preparations in the Republic laboratory at that time. The facilities for this work were very limited, and I think—I cannot recollect now that we did prepare very many.

19. Q. Then these substances that you used in these tests were bought from outside concerns?

A. Yes, sir.

20. Q. Can you name some of the concerns that you know were among those from whom you bought?

A. Why, one of our best supply houses was Eimer & Amend, of New York; and I remember of getting some special chemicals—remember the name of Holland Chemical Company of Chicago.

21. Q. And what was the nature of the work that you did with these chemicals?

A. Tried them out in rubber mixes.

22. Q. You compounded a rubber mix and then made a rubber slab?

A. Yes.

23. Q. And vulcanized the slab, in the course of the usual procedure in all rubber laboratories?

A. Yes, sir.

24. Q. Will you please look at the 2000 X-book, which is in front of you, and state whether any of the entries in there were made by you?

A. This is the old X-book that was given me by Brill—I don't think it is the X-book that was given me when I went there, but one that I used while there, during the latter part of the time that I was in the chemical laboratory. There are entries made by me in the first ten pages of the book.

25. Q. Are the entries on this page X-2010 at the left made by you, or some of them?

A. Some of them were.

26. Q. And on all of the preceding pages there appear to be entries made by you, back to the first page, which is blank?

A. Yes, sir.

27. Q. Here at the bottom of the page, opposite X-2001, seems to be quite a bit of matter. Do you recognize that as having been put there by you?

By Mr. Wooster:

I object to that as leading. I suggest that counsel not lead the witness on a matter like this

By the Court:

Well, of course that is leading. It calls for a direct answer.

28. Q. Is all of the matter on that page matter which was put there by you?

A. Yes, sir.

29. Q. Look at this matter on X-2002,—is all of the matter that is written or printed there, is that yours?

A. That is all mine.

30. Q. Take the opposite page, is that yours?

A. That is mine.

31. Q. This next page, X-2003?

A. That is all mine.

32. Q. And the opposite page?

A. Yes.

33. Q. X-2004, is that yours?

A. That is all mine.

34. Q. Both sides?

A. No, I didn't write that up there (indicating).

35. Q. The matter at the top of the page opposite page X-2004, reading, "Reverse of X-2005," with some initials under it, was not put there by you?

A. No.

36. Q. That is right?

A. That is right.

37. Q. Now, will you look at the next page, X-2005, and state what, if anything, on that page was put there by you?

A. The entry number, X-2005, is in my handwriting. "Action of organic accel." is in my handwriting. The reference, "X-2004-C" in parentheses, at the lefthand top column, is mine. The printing

"diphenyl guanidine", the first column to the left, is mine. The figures in the first column are all mine. The total figure, "101," is mine. The cure "120" is mine. The entry "N. G." is mine, and the date,—all in my own handwriting.

38. Q. These figures to which you have referred, and the cure, and "N. G." and the date, are the figures and letters, and so forth, that appear in the left of the column headed "A"?

A. Yes, sir.

39. Q. What date do those figures at the bottom of the column indicate?

A. February 22, 1917.

40. Q. From the record of that experiment, to which you have referred, are you able to say whether or not you conducted that experiment at that time?

A. Yes, sir.

41. Q. Any question in your mind about that?

A. Absolutely none.

42. Q. You know you made that experiment?

A. I do.

43. Q. And what do you know as to the date when you made it?

A. On or about February 22, 1917.

44. Q. No question in your mind about that?

A. Absolutely none.

45. Q. And as to the fact that this word "diphenylguanidine" was written here by you have stated, is there any question in your mind about that?

A. Absolutely none; that is my handwriting.

46. Q. And the same as to this heading "Action of organic Accel."?

A. That is mine.

47. Q. And all of that matter that you say was put there by you, was it all put there at the same time?

A. Within about a day or two, I should say. It might not all have been entered the same day. The results down near the "N. G.", the date would probably be within two or three days from the time the compound was written. I can't recollect just exactly.

48. Q. What is the reason for that?

A. Well, when I would start to make experiments, I would enter the compound in my book for reference, and then I would give the compound to the compound man downstairs, and it might be a day or two later when I got results.

49. Q. So that the whole experiment that is referred to there might cover a couple of days, or even three days?

A. Yes, sir.

50. Q. Now, look at page X-2006,—and as there are two pages numbered 2006, it is the second one to which I refer—and state whether or not the matter appearing there was put there by you?

A. Yes, sir.

51. Q. Now, look at the matter on the page opposite—the unnumbered page opposite, is that yours?

A. Yes, sir.

52. Q. What about the matter on page 2007?

A. That is all mine.

53. Q. Including this title, "Comparison of Action of Accelerators"?

A. Yes, sir.

54. Q. And these dates at the bottom?

A. They are all mine.

55. Q. And the matter on the opposite page, in the columns headed by printed letters?

A. Well, that is another entry.

56. Q. But the matter in the columns of figures that you show was put there by you?

A. Yes, sir.

57. Q. And the other matter, up at the extreme top of the page, was not put there by you?

A. No, sir.

58. Q. Going back here to page 2007, the matter which you say was put there by you, does that include these dates at the bottom?

A. Yes, sir.

59. Q. And were the experiments recorded there made on the dates indicated by those figures at the bottom?

A. Yes, sir, on or about the date.

60. Q. What about X-2008, was the matter on that page put there by you?

A. Yes, sir.

61. Q. And similarly as to the matter on the opposite page?

A. Yes, sir.

62. Q. 2009, is that your work?

A. That is my work.

63. Q. And on the opposite unnumbered page?

A. Yes, sir.

64. Q. How about 2010,—is that your work?—I refer to the page at the left—Is that your work on this 2010 at the left?

A. Well, there is some writing there that isn't mine (indicating).

65. Q. You refer to certain words written in the

first column at the left, including "Brown crepe," "Batanga," "Usam," "Trifan," and something else that looks like "Inertia". Those words that I have just read were not written there by you?

A. No, sir.

66. Q. These parts that you have just referred to as having been put there by you are the printed parts "MRX" and "Excellerex". Is that right?

A. That is right.

67. Q. And the figures in these four columns at the left, were they put there by you?

A. Yes, sir.

CROSS-EXAMINATION.

By Mr. Wooster:

X68. Q. Did you say in direct examination where you got the D. P. G.?

A. No, sir.

X69. Q. Do you know where you got it?

A. No, sir.

X70. Q. Did you make it?

A. No, sir.

X71. Q. Did you buy it?

A. I expect we did; yes, sir.

X72. Q. I asked you if you bought it?

A. Yes.

X73. Q. You personally?

A. No, sir.

X74. Q. Who did?

A. Through the purchasing agent, I expect, of the Republic Rubber.

X75. Q. Do you not know?

A. No, sir, I don't.

X76. Q. Did you test it when you got it?

A. I tested it in the sample the same as the other.

X77. Q. How did you know what it was?

A. As I recollect, I went by the label on it. I wasn't very well acquainted with that, any more than I was with other accelerators that I was working with.

X78. Q. What was it marked on the package?

A. I don't remember.

X79. Q. Did you get the original unbroken package?

A. I don't remember.

X80. Q. Did it have a wrapper on it?

A. I don't remember.

X81. Q. Was the cork sealed, or was it a screw-top package, or what?

A. I don't remember.

X82. Q. How much was there?

A. I don't remember.

X83. Q. Can you say whether there was a pound or ten pounds, or five grams, or one gram?

A. I should say in the neighborhood of five grams. That is what they put up for a sample test.

X84. Q. You now say you bought a package containing five grams?

A. Well, I would say that would be about the amount we would get.

X85. Q. Is that the amount you ordered?

A. Yes.

X86. Q. You told the purchasing agent to order five grams?

A. That would be about the amount there would be in a sample?

X87. Q. Did you tell the purchasing agent to order five grams?

A. No, I wouldn't go up and tell him.

X88. Q. How big a package would five grams make?

A. A small bottle.

X89. Q. How much?

A. About—Oh, an inch in diameter and five inches high, I would say.

X90. Q. An inch in diameter and five inches high, filled?

A. Yes, sir.

X91. Q. And that is five grams?

A. About that, I should say.

X92. Q. What was the color of this material?

A. White crystalline substance.

X93. Q. Granular?

A. As I remember, it was crystals.

X94. Q. Crystals?

A. Yes.

X95. Q. Like coarse sugar?

A. No, finer than that, very fine.

X96. Q. Powder?

A. Yes, sir.

X97. Q. And you took this material just as you got it and put it into a cure?

A. Evidently, from the records of the X-book.

X98 Q. You took no melting point on it?

A. No, sir.

X99. Q. Did you order material of any melting point?

A. I don't remember.

X100. Q. Did you order chemically pure material?

A. I don't remember.

X101. Q. At that time did you know as a fact that drug houses frequently carry what they call "C. P." and also commercial grades of the same material?

A. I don't know as I could state that I knew whether drughouses carried either one.

X102. Q. You are sure you did not make this material?

A. No, sir.

X103. Q. You know you didn't make it?

A. I know we didn't.

X104. Q. Did you specify any melting point for this material?

A. That I don't remember.

X105. Q. What was the melting point of D. P. G.?

A. 147.

X106. Q. Where did you get that?

A. Out of my literature.

X107. Q. What literature?

A. I don't remember.

X108. Q. When did you get it?

A. In refreshing my memory, I looked it up.

X109. Q. I asked you when you got the information that D. P. G. melted at 147?

A. I don't know.

X110. Q. Have you recently looked it up?

A. Why, I have looked over some of the records of D. P. G. I don't know—I have known it for some time, what the melting point of it was.

X111. Q. What records have you recently looked over?

A. None.

X112. Q. You just said you had recently looked over some records.

A. I don't know to what you refer by "records."

X113. Q. Records that said anything about D. P. G.

A. The only—practically the only records I have read over is the last testimony in this case, or in the Anilin National case.

X114. Q. You mean your testimony in the New York case, of Dovan vs. National?

A. My testimony and other testimony in there.

X115. Q. Oh, you read a lot of testimony in this Dovan vs. National record before testifying here?

A. Yes; looked it over, naturally.

X116. Q. Why should you look over the entire record?

A. What was that?

X117. Q. Why should you look over the entire National record?

A. I am naturally interested in it when I am testifying in the case.

X118. Q. Now, how long had you been at the Republic by February 22, 1917?

A. Why, I went with the Republic in the middle of the summer of 1916.

X119. Q. What month?

A. To the best of my recollection, about August.

X120. Q. You are not positive as to the month when you went there, but you are positive as to this test on X-2005. Is that right?

A. Yes, sir.

X121. Q. You have got the day of the test—

A. Right before me.

X122. Q. Right in your mind?

A. Right before me.

X123. Q. Oh, you read it from this book?

A. Yes, sir.

X124. Q. Without the book, could you say when the test was?

A. Well, just from memory,—that is refreshed in my mind now.

X125. Q. You remember February 22, 1917?

A. Only through the records.

X126. Q. But you don't remember the day you went with the Republic?

A. No, sir.

X127. Q. What did you do at the Republic when you first went there?

A. Why, I worked on accelerators and did other special work that Mr. Brill gave me.

X128. Q. What was the first accelerator that you worked on?

A. Thiocarbanilid.

X129. Q. What did you do with it?

A. Experimented with it, became acquainted with it.

X130. Q. Analyze it?

A. No.

X131. Q. Take a melting point on it?

A. I don't remember.

X132. Q. Make a test for ash?

A. Why, I expect I did. That is rather routine work. I don't remember.

X133. Q. What was the next you had to do with?

A. Why, I don't just remember the order, the way I took them up. I experimented with several trade accelerators.

X134. Q. What were their names?

A. Well, we had samples of Excellerex, and I don't recall just—

X135. Q. I mean, prior to February 22, 1917, what accelerators had you worked with at the Republic?

A. They are in the book there.

X136. Q. I asked you to state from memory?

A. I am not able to state; I don't remember.

X137. Q. How many had you worked on yourself before you, as you say, made this D. P. G. test,—how many different accelerators?

A. Oh, I should say four or five.

X138. Q. Will you give their names?

A. I don't remember.

X139. Q. You now say that D. P. G. was about the fifth or sixth on the list of those you worked with?

A. It is a matter of record in the X-book there.

X140. Q. I asked you for the recollection.

A. I should say fourth or fifth or sixth, somewhere around in there—just a few.

X141. Q. And how many tests had you made on the others—roughly?

A. Oh, some of them I would make four or five tests on.

X142. Q. What was your occupation just before you went with the Republic?

A. I was doing some work for the H. Koppers Company.

X143. Q. H. Koppers Company?

A. Yes, sir.

X144. Q. That is not a rubber company, is it?

A. No, sir.

X145. Q. What is it—coal tar?

A. By-products.

X146. Q. By-products?

A. Yes, sir.

X147. Q. What was that work?

A. Doing some laboratory work.

X148. Q. Laboratory work on what?

A. On the recovery of nitrogen as a by-product in coke-oven work.

X149. Q. And you went from that by-product and coke-oven work into a rubber company and started right away to know all about rubber compounding and how to put accelerators in. Is that right?

A. I did not so state.

X150. Q. Well, did you?

A. No, sir.

X151. Q. But you learned very fast on rubber after you went with the Republic?

A. No, sir; I had had previous experience in rubber.

X152. Q. You had had previous experience in rubber where?

A. With the Ajax Rubber Company, at Trenton.

X153. Q. For how long?

A. Three years.

X154. Q. During what period?

A. 1912 to '15.

X155. Q. Doing what?

A. Laboratory work.

X156. Q. On what?

A. Why, it was routine work on ingredients of rubber.

X157. Q. You mean, testing rubber materials for specifications?

A. Yes, sir.

X158. Q. You didn't do any work on curing rubber at the Ajax, did you?

A. No, sir.

X159. Q. How much of that five grams did you use in that test of February 22, 1917?

A. I don't remember.

X160. Q. How much was the batch you made up?

A. I don't remember that.

X161. Q. You don't remember any of the weights?

A. No, sir.

X162. Q. Can you say now what was in that batch and how much of each?

A. Fifty pounds of smoked sheets—fifty parts of smoked sheets, forty-seven parts of zinc oxide, three parts of sulphur, one part of D. P. G.

X163. Q. You don't know how big the parts were?

A. I don't remember.

X164. Q. In the National case, you were asked if you could recall where the Republic Rubber Company obtained the D. P. G. which you say you used, and you answered, "I cannot." That was in 1923. You now say you had the purchasing agent buy it. Which answer is correct?

A. Both, I should say.

X165. Q. Why could you not recall that you had the purchasing agent buy it, when you testified in 1923?

A. I don't think I was asked the question.

X166. Q. I will read X-34 of your direct examination into the record, and ask you the same question now: "Can you now recall where the Republic Company obtained the diphenylguanidine which you say you used in your experiment recorded there?"

A. No.

X167. Q. So you are not positive now whether the purchasing agent got it for you, or whether you found it in the street, or found it on a shelf in your place, or somebody gave it to you, are you?

A. Just what question do you want me to answer—the one in the book or the one you asked me?

By Mr. Wooster:

I will withdraw the question.

X168. Q. Can you now state of your own recollection whether you found that D. P. G. in your place, or somebody gave it to you, or you had the purchasing agent get it for you, or you made it yourself.

A. I did not make it, and I would expect that

the purchasing agent would purchase it, but I am not certain as to where it came from.

X169. Q. What did you mean by the notation "N.G." opposite the printed word "stretch," in this test dated 2-22-17?

A. That particular experiment was no good.

X170. Q. In what respect?

A. No doubt the slab was over-cured.

X171. Q. How do you know that?

A. In view of information I now have along those lines.

X172. Q. You mean, you now conclude that "N.G." meant overcure, because of information which you have acquired since?

A. I am not exactly certain that that is the answer.

X173. Q. Couldn't "N.G." mean undercured?

A. That experiment, as outlined there, in my opinion at the time, was no good. For what reason, I am not able to state definitely.

X174. Q. You mean, you cannot now state whether it was undercure or overcure?

A. Not strictly from that record.

X175. Q. From that record?

A. From my own knowledge of rubber.

By Mr. Edmonds:

Is it understood that the meaning of this last thing in the record is that he cannot say it was overcured or undercured from what appeared there, but as a deduction from his present knowledge, he thinks it was overcured?

By Mr. Wooster:

That is what he said.

By Mr. Edmonds:

I thought so. I have nothing further.

Adjourned until Tuesday, October 13, 1925, at 10 o'clock, A. M.

MORNING SESSION.

Tuesday, October 13, 1925.

By Mr. Edmonds:

I offer in evidence a certified copy of the affidavit of Mr. Weiss' in the National case, which was referred to in the cross examination of Mr. Weiss and at that time was marked for identification, Defendant's Exhibit "A".

By Mr. Kennedy:

I ask for what purpose that is introduced. Whether it is for the purpose of impeaching or attacking the credibility of Mr. Weiss.

By Mr. Edmonds:

It is offered for any purpose which will serve and among others as showing gross inaccuracy in the testimony of Mr. Weiss.

By Mr. Kennedy:

That is objected to. There has been no offer to have the witness Weiss explain discrepancies if there are any, between his testimony and previous statements.

By the Court:

He was asked on cross examination whether he did not make certain statements in the affidavit. If there is anything contradictory of this evidence I think it may be introduced. At least portions which differ from the testimony given in the instant suit.

By Mr. Kennedy:

I had overlooked the fact that his attention was called to some particular parts of that affidavit and as to those parts of the affidavit of course my objection would not apply, but I repeat it as to the balance of the affidavit.

By the Court:

It is irrelevant in so far as anything else except the portions which are offered for the purpose of showing that he made a different statement at another time.

By Mr. Edmonds:

I also offer in evidence a copy of the application of Mr. Weiss for employment with the National Analine & Chemical Company which is marked defendant's Exhibit "B". It was conceded in that connection that that is an accurate copy of the original.

I also offer in evidence the original application of Mr. Weiss for employment with the Firestone Rubber Company which is marked Defendant's Exhibit "C".

I also offer in evidence a copy of the Brief for Weiss in the interference referred to in the

cross examination of Mr. Weiss with relation to the accelerator known ditolylguanidine. This brief being marked Defendant's Exhibit "D".

I also offer in evidence as Defendant's Exhibit "E" the original letter from Mr. Daniels to Mr. Stevens which was identified by Mr. Daniels during his cross examination.

I offer in evidence Exhibit "E" being a copy of a paper written by Messrs. Kratz, Flower and Coolidge and read by Dr. Kratz at the meeting of September, 1919, of the American Chemical Society at Philadelphia, Pa.

By Mr. Wooster:

The publication date of this paper as of April, 1920, has heretofore been agreed to, but the paper itself is objected to as immaterial and irrelevant and as merely a fortuitious publication made by parties not shown to be in privity or connection with Mr. Weiss in any way and long subquent to his date of invention. So far as the date of the reading of this paper as between September 2nd and September 6th, 1919, is concerned the alleged reading thereof is objected to as not shown to be exactly as appears by the later publication. It is further objected to as incompetent because a mere reading or lecture is not in any event a statutory bar, nor in this case did such reading antedate the date of invention by Weiss of the patent in suit.

By the Court:

If there is a disputed question as to the time of invention and other matters and the paper is

in view of the testimony that has already been given in connection with it, it is admissible, the objection is overruled and an exception noted.

By Mr. Edmonds:

I offer in evidence as Exhibit "G" the circular of the Dovan Chemical Corporation, which was referred to in the cross examination of plaintiff's witness Woodward. Also during the cross examination of the witness Woodward reference was made to another circular of the Dovan Chemical Corporation, a copy of which appears in the proceedings in the Patent Office which led up to the grant of the Weiss patent in suit.

I now offer in evidence as Exhibit "H" a certified copy of the file wrapper as we call it in the Patent Office, of the patent in suit. That is a record of the proceedings that led up to the grant of the patent.

I also offer in evidence as Exhibit "I" the original stipulation signed by the solicitors of both parties to the suit covering certain items of proof and designed primarily to eliminate from this suit certain proceedings which would have amounted to a duplication of what was done in the National suit. This stipulation provides that certain depositions that were taken in the National suit may be offered in evidence here and received with the same force and effect as if those witnesses were called here and gave their testimony. Perhaps at a later time it may assist your Honor for me to give a brief statement as to what is in those depositions. In addition to that the

stipulation provides that a number of publications in magazines along in 1916, 1917 and 1918 shall be accepted without further proof that they were published as of those dates. That applies to a number of publications that we shall have occasion to offer in evidence. Perhaps it would serve the purpose best to have this stipulation copied into the record.

STIPULATION.

"It is Hereby Stipulated by and between counsel for the parties hereto that, as a portion of defendant's case herein, copies of despositions heretofore taken in the suit of this plaintiff against National Aniline & Chemical Co., Inc., referred to in companion stipulation of even date herewith respecting said suit and plaintiff's prima facie case, may be offered and received in evidence herein and shall be given the same force and effect herein as if each of the said witnesses in the National Aniline suit were produced, sworn and so testified herein, as follows:

SETH R. CLARK
JAMES W. KINSMAN
ALFRED L. LOEBENBERG
ROBERT L. MOORE
HENRY V. MOORE
WILLIAM E. RUSSELL
NORMAN A. SHEPARD

and together with the following exhibits offered in evidence by defendant in said National suit

and received and marked in evidence therein as follows:

Article by Kratz, Flower and Coolidge in Journal of Industrial and Engineering Chemistry, April, 1920, pages 317-324, defendant's Exhibit A.

Abstract on page 430 of Chemical and Metallurgical Engineering for Oct. 1, 1919, of paper by Kratz, Flower and Coolidge, subject to proof by defendant of the actual date of publication thereof, part of defendant's Exhibit B.

Set of Cards showing 1913 work, Exhibit C.

Set of Cards showing work at Norwalk, defendant's Exhibit D.

Notebook sheets, defendant's Exhibit E.

Tests on T-63 compound, defendant's Exhibit K.

Firestone employment application, defendant's Exhibit I.

National employment application, defendant's Exhibit M.

Metallurgical and Chemical Engineering, Sept. 1, 1916, pages 231-234, article by King, defendant's Exhibit O.

Journal of Society of Chemical Industry July 31, 1917, pages 782-789, article by Twiss, defendant's Exhibit P.

The India Rubber World, May 1, 1921, pages 572-573, article by Scott and Bedford, defendant's Exhibit Q.

Journal of Industrial Engineering Chemistry for January, 1922, pages 25 to 31, article by Bedford and Sebrell, Exhibit 15.

Translation, Le Caoufchoue et La Guttapercha, July 15, 1919, pages 9861-9864, article by Du Boso, defendant's Exhibit S.

File Wrapper and contents of Weiss patent in suit #1,411,231, defendant's Exhibit X.

Plaintiff waives other proof than the dates appearing thereon of the publication dates of said Exhibits A. O. P. ", S and 15.

In making the within stipulations as to the named witnesses and exhibits to be received in evidence herein on behalf of defendant in order to save time and expense, plaintiff reserves all rights of objection other than as to mode of proof and also all rights of rebuttal. Dated, June 3, 1925. (Signed) J. S. Wooster, Counsel for Plaintiff; (Signed) Pennie Davis Marvin Edmonds, Counsel for Defendant."

By Mr. Edmonds:

I offer in evidence as Exhibit "K" a copy of Chemical and Metallurgical Engineering for Oct. 1, 1919, page 430, this being one of the articles referred to in the stipulation that I have just mentioned.

By Mr. Wooster:

This stipulation refers to this article but says "Subject to proof by defendant of the actual date of publication thereof." This publication is ob-

jected to by plaintiff as incompetent because its actual date of publication is not proven, the printed date of Oct. 1st, being not even prima facie proof. This is the paper as to which counsel for defendant stated the other day he had no witness to prove the publication date.

By Mr. Edmonds:

May I say that the publication did not come into the hands of the public until a few days after Nov. 12, 1922.

By Mr. Wooster:

Nov. 12th or Nov. 15th or 16th or thereabouts, 1919, which was less than two years before the filing date of the patent in suit.

By Mr. Edmonds:

Then I think I am entitled to have the publication admitted in evidence as a publication of the last half of Nov. 1919.

By Mr. Wooster:

We make the same objections to it then as we do to the complete paper published in April, 1920.

By Mr. Edmonds:

That is the complete paper of Kratz. The entire paper as published in April, 1920, Exhibit "E".

By the Court:

You are now offering another paper.

By Mr. Edmonds:

A brief abstract of it published in the preceding fall.

By the Court:

We will admit it subject to later ruling.

By Mr. Edmonds:

I offer in evidence a copy of Metallurgical and Chemical Engineering of Sept. 1, 1916, pages 231, 232, 233 and 234 containing an article on "Rubber Vulcanization Accelerators, by Andrew H. King being marked Exhibit "L".

I offer in evidence a copy of pages 782 to 789 of the Journal of the Society of Chemical Industry for July 31, 1917 containing an article on the chemistry of Vulcanization by D. F. Twiss, marked Exhibit "M".

I offer in evidence an article appearing in "The Rubber World for May 1, 1921 pages 572 and 573 containing an article on Reactions of Accelerators during Vulcanization by Scott and Bedford marked Exhibit "N".

I offer in evidence as Exhibit "O" a translation of an article that appeared in a French magazine for July 15, 1919 entitled "Le Caoutschoue et La Guttapercha." The stipulation previously referred to covers the publication of the original article in French, and the fact that this document is a translation of it.

DR. GEORGE D. KRATZ, called on behalf of the defendant, being duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Edmonds:

1. Q. Will you state your present residence and your present business connection?

A. My present residence is Akron, Ohio. I am vice president of the Falls Rubber Company.

2. Q. That is located where?

A. It is located on Cuyahoga Falls, Ohio.

3. Q. Just outside of Akron?

A. Yes, sir.

4. Q. You are the vice president. Are you the active managing officer of the company under the present board of directors?

A. Yes, sir.

5. Q. And the Falls Rubber Company is engaged in the manufacture of automobile tires and tubes? That is their primary product?

A. We make practically nothing but tires.

6. Q. Are you a graduate of a technical school and if so what and when did you graduate?

A. I graduated from Cornell University in 1912 with the degree of Bachelor of Chemistry.

7. Q. What did you do on leaving college?

A. On leaving college I went to the Diamond Rubber Company in the research laboratories under Dr. David Spence, for whom I had worked in the summers of 1910 and 1911 doing work along general research lines in rubber.

8. Q. How long did you stay with the Diamond Rubber Company?

A. I went there in February, 1912, and stayed with the Diamond until April 1, 1914, as I remember it, during which time the consolidation of the Diamond Rubber Company and the Goodrich Rubber Company took place, and there was some ill feeling on the part of some of those who had previously been with the Diamond, and Dr. Spence and his associates decided to form a company of their own and asked me to go with them and at that time in April, 1914, I left to join Dr. Spence at Norwalk, Conn., with the Norwalk Rubber and Tire Company.

9. Q. How long did you stay with them?

A. I was with the Norwalk almost three years to the day, from April 1, 1914 to about April 1, 1917, at which time I went to the Falls Rubber Company to take charge of their chemical laboratories staying with the Falls Rubber Company since April 1, 1917, until the present time.

10. Q. When you were with the Diamond Company and prior to its consolidation with the Goodrich Company was any work done there on accelerators for the vulcanization of rubber?

A. The Diamond Rubber Company was really the birth place of accelerators according to my idea and I believe according to—

By Mr. Kennedy:

Objected to. That is a conclusion on the part of the witness and I object to it as not responsive to the question and volunteered.

By the Court:

We will allow the motion. The witness should answer directly.

By Mr. Edmonds:

11. Q. Will you state what was done there at the Diamond Company in the way of accelerators, refraining from any expression of opinion as to whether that was the birth place of the use of accelerators?

A. Certainly organic accelerators were used by the Diamond Rubber Company in 1910 to my actual knowledge and in 1911 and 1912 I myself worked with organic accelerators at the Diamond Rubber Company, together with the other members of the laboratory, and the research laboratories at that time were more interested in organic accelerators than in any other one substance.

By Mr. Kennedy:

I do not like to be interrupting because it delays things, but at the same time for the purpose of really shortening things I think this witness should be instructed to answer the question. I object to that part of his answer, and move to strike it out, in which he says that in 1910 the Diamond Company was working on accelerators. He wasn't there. He didn't reach there until 1912.

By the Court:

That is a direct statement. However it may later develop under cross examination that it should be stricken out.

By Mr. Edmonds:

12. Q. Will you state what the basis of your knowledge is about the work on occelerators at the Diamond in 1910?

A. Your Honor the attorney for the plaintiff just mentioned that I was not at the Diamond in 1910. I just previously said that I was there in the summer of 1910 and the summer of 1911 and went to work there permanently in 1912.

13. Q. So that your statement is based on actual knowledge of what you, yourself did?

A. Yes, sir.

14. Q. Do you know whether the Diamond Company took any prominent part in the development of the use of organic accelerators in the vulcanization of rubber?

A. They took the leading part.

By Mr. Kennedy:

That is objected to and I move to strike it out on the ground that there is no foundation laid for such statement by this witness.

By the Court:

Is there any contention on your part that this is the original of accelerators in rubber. I don't so understand it. If there is not it seems to me we are wasting time on these motions.

By Mr. Edmonds:

15. Q. During the course of your work with the Diamond Company, did you, yourself do any work in connection with one of the accelerators of rubber vulcanization?

A. I did, yes, sir.

16. Q. Will you state just what that was that you did while with the Diamond Company, that is, prior to 1914 when you say you left them?

A. In 1913 I prepared certain derivatives of guanidines, particularly naphthylguanidine, and so forth.

17. Q. Will you state a little more fully what that work was and the nature of it, and the result of it?

A. The work briefly was the condensation of alphalithasmine with thiocarbanilid, by heating. That is, the reaction product was a guanidine derivative, probably a thiophenylguanidine, and that substance was tested out over a range of compounds in rubber; that is, I took portions of the reaction product and mixed it in with the rubber and sulphur, vulcanized the two over a range of times and temperatures, and tested the different slabs to note whether the product vulcanized faster than without any accelerator present, or if it vulcanized faster than either one of the constituents that went into the mentioned products.

18. Q. Was this work of yours particularly with guanidines in line with the general line of work that you were doing with the Diamond Company?

A. It was along the general lines that I was doing, yes, sir.

19. Q. Will you state what the papers that I now hand you are?

A. The cards represent my own personal work with regard to the preparation of diphenylguanidine. They show the object of experiment, the method of

preparation of the substance, the preparation of the compounds, the method of testing and briefly the results of the tests.

20. Q. Those are your personal records?

A. Yes.

21. Q. Where did they come from?

A. These came from my personal files.

22. Q. In Cuyahoga Falls?

A. My home in Akron.

23. Q. State generally what that personal file is?

A. The file represents my own record of the work that I have done in chemistry since 1910 and consists of cards of this size and type filed according to the regular subjects by letter. I can't say the exact number of cards but it runs into the thousands.

24. Q. Thousands of cards of which these are samples and all made out by you?

A. Yes, sir, that is all the original experiments were made out by me.

25. Q. Do all of them relate to accelerators or is there a special group relating to accelerators?

A. The cards relate to my work with rubber. There are a large number of cards on accelerators.

26. Q. And they are collected together by themselves?

A. There is a drawer for accelerators.

27. Q. And in that drawer there are thousands of cards?

A. I wouldn't say thousands of cards on accelerators, but there is a large number of cards.

28. Q. Many hundreds?

A. Probably.

By Mr. Edmonds:

I will offer in evidence the cards just referred to by Dr. Kratz, as defendant's Exhibit "P".

By Mr. Edmonds:

29. Q. You say you left the Diamond Company in 1914 and went with the Norwalk Rubber Company and there you say you work in association with some Dr. Spence who had been with the Diamond. Who else were you associated with?

A. My immediate superior was Dr. William Russell, with whom I had worked in Akron, both of us being under Dr. Spence.

30. Q. Is that the Dr. Russell who testified for the defendant in the National Anilin suit on this Weiss patent?

A. Yes.

31. Q. You two, were associated in the Norwalk Company?

A. Yes, sir. We were the only two men when we first went there who were directly working on chemical work.

32. Q. And were you closely associated?

A. We were very closely associated. In fact we roomed together for a period of the year.

33. Q. And you were both working with the Norwalk Company on the same lines of Chemical work?

A. Yes.

34. Q. What was the nature of that work?

A. When we first went to Norwalk of course there was no laboratory inasmuch as we converted an old plant into a rubber factory. Our first work was

to build a laboratory to carry on the routine tests necessary to get started and then we prepared certain chemicals and accelerators for use in the factory when it became started. Our work there was amplified more than it was at the Diamond because we actually prepared at Norwalk many of the accelerators that were used in the factory.

35. Q. So your work included not only experimentation but supervision of the actual manufacture of accelerators for use in the manufacture of rubber?

A. In many cases, yes.

36. Q. When you first went there you had to organize the laboratory and thereafter you started this experimental work. In the course of this experimental work while still at Norwalk did you do anything further with guanidine and guanidine derivatives?

A. Yes. We prepared our original accelerators at Norwalk for actual use in the factory and then later on Mr. Smith one of the editors, and I believe owner, of the India Rubber Review, who was the father-in-law of Dr. Russell, asked us to prepare a paper for his publication. In the course of this correspondence I prepared a paper for him on Rate of Vulcanization in Factory Output. This was in 1916 as I remember it. That paper according to Mr. Smith was very well received by his subscribers and he asked us to give him material for additional papers. In the course of that work, the preparation of the paper there was certain work carried on with regard to accelerators, which, by the way, included guanidines, but on going over it with Dr. Russell he concluded that the work was of practical importance and not a subject for publication. That paper never appeared

but in the course of its preparation we did certain work on guanidines and in fact had been doing it prior to that time.

37. Q. Will you state just what that work was?

A. That work consisted in the preparation of a series of closely related compounds to determine their accelerating activity, as we desired to find out whether or not it would be possible to anticipate in advance what the accelerating activity of certain substances might be. That is, we wanted to find out if knowing the activity of one substance we could calculate the activity of another substance very closely related to it chemically. On going over the different series of compounds, the first accelerator that was considered, I believe, was thiocarbanilid, which of course, was one of the very earliest and best known accelerators. Also it was a very good substance to experiment with as the construcion of it chemically, its formulae, lends itself to easy change and it is closely related to a number of other substances. For example another name for thiocarbanilid would be diphynelures, as I remember it. We would also get a good start with certain ureas, and build up from complex compounds, and as I mentioned before we ought to be able to calculate the accelerating activity of some of these compounds. The result was we started in with the simplest, namely, the urea and thiourea, monophenylguanidine and diphenylguanidine. They are all related, and worked these out and prepared them after making my theoretical tests, and the actual compounds, and determine their purity. I then took the pure substances and mixed them in with my rubber and sulphur to determine whether or not the addition

of these substances would increase the rate of vulcanization of the rubber. That of course, involved a great deal of work inasmuch as it was necessary to prepare not only one compound, but several compounds or mixtures, vulcanizing each mixture not only at one temperature but over a range of temperatures, and then taking an estimate of the quality or strength of the different rubbers, also by physical tests and the ordinary thumb and tooth method. Then after you have done all that you usually find that you have misjudged your quantity and you have to repeat the experiment with either a greater or lesser amount of accelerator, or with a shorter or longer range of time. It was a rather elaborate piece of work and I felt very conclusive.

38. Q. Just what did this work involve in the way of what it was that you produced and the laboratory tests that you referred to in each instance, results in the production of what?

A. You mean the physical results?

39. Q. Yes.

A. It results in a slab of rubber which the average laboratory practice has for test work usually about five inches by five inches by three-sixteenths of an inch thick. Those slabs are made in that particular size and in order that they may be easily adaptable for handling, that is, by the thumb and tooth method, or will be large enough to test on a testing machine by punching out the desired type of sample that you wish from this slab. Usually we got three test samples from one of these slabs.

40. Q. You had a vulcanizing press for making these slabs in your laboratory?

A. Yes, we have three as I remember it.

41. Q. What I am getting at is that the usual procedure, a standard procedure in chemical laboratories, in the mixing of batches and making vulcanized slabs in a press were you doing something unusual in that particular work?

A. No. Your average laboratory particularly a small rubber company, and even the large ones, consist primarily of a small mixing mill which is identical with large mixing mills in the factory and two or three vulcanizing presses for the preparation of these slabs. You simply take the prepared batch of rubber, put it in the proper type of moulds, put the moulds in the vulcanizing press and put it under hydraulic pressure, with a steam heated plate on either side. The steam heated plate heats up the rubber mixture and vulcanizes it. That is the common practice of preparing test slabs.

42. Q. And always has been?

A. So far as I know, yes.

43. Q. I show you another group of cards, will you state what they are, and in whose handwriting they are, and what their significance is?

A. This first card shows the formulae used for testing different substances more or less closely related to thiocarbanilid. Upon it I have expressed the amounts of these substances, to give an accelerating activity equal to aniline. The second card No. 3, outlines a further experiment with reference to phenyl-mustardoil, which was found to be inactive, that is, it did not accelerate the vulcanization of rubber. It is, however, of interest inasmuch as phenyl-mustard-oil has a very powerful smell and it is one of the de-

composition products of thiocarbanilid. It was thought at that time when we carried on those experiments that possibly it might be the accelerating principle or part of sulph-carbanilid. This experiment shows that is was not.

The other cards show a similar experiment and outline the activities of the substances.

The last card gives a brief method of preparing the different substances used. In this connection here, I might mention that the urea which I prepared at that time heated ammonium-cyanid—the action of it is somewhat different from the action you get by buying the absolutely C. P. product on the market.

44. Q. In whose handwriting are the notations on these cards?

A. These cards are all in my own handwriting.

45. Q. Are the cards from your personal collection of cards in Akron, in connection, as you stated, with the other cards?

A. Yes.

46. Q. And you found them there yourself?

A. Yes, sir.

47. Q. So far as you know they had been there until you got them out for use in the litigation on this Weiss patent?

A. I got them out for use in the litigation of the National Anilin Company.

48. Q. Now as I understand that is a record of just what you did at Norwalk for your personal use. Did you also leave at Norwalk any record for the company to retain, with reference to this same work?

A. Yes. I left a more complete record for the company than is probably shown by those cards.

49. Q. What is the group of pages that I now hand you?

A. These sheets are the original sheets left with the Norwalk Tire and Rubber Company outlining the work which was summarized on the cards. However, they go into the details of the proportions much more completely than is shown on the cards. In fact these records are about as complete as you ever find laboratory records.

50. Q. In whose handwriting are they?

A. They are all in my own handwriting.

51. Q. Now did you state just when it was that you did this work at the Norwalk Company?

A. This work was done over quite a period of time. Not later than October 31st or November 1, 1916. You understand that the work represented by these sheets here and the cards cannot be written up until the experiments have actually been completed, and as to just how much prior to the dates given on these sheets the work was carried on I couldn't say.

52. Q. These personal cards of yours and the Norwalk record sheets both cover the same line of work, the same work done by you?

A. Yes, that is right.

By Mr. Edmonds:

I offer in evidence the second group of Dr. Kratz's personal cards as Exhibit "Q".

I also offer in evidence the Norwalk record of Dr. Kratz's work as Exhibit "R".

By Mr. Edmonds:

53. Q. Now will you state whether or not this Norwalk record, Exhibit "R" is a record of the making of individual tests, the production of individual test slabs, or a record of the conclusion drawn from the production of many slabs?

A. No. For example here you will find half a dozen or more different test formulae, showing the mixtures that were used to try out these different substances. Each one of these mixtures added up to something over four or five hundred grams which is enough to prepare at least four or five test slabs. Each of these test slabs was then vulcanized at different temperatures; that is, the batch was divided into four parts, slabs were made and the four slabs vulcanized at different temperatures. In some cases different amounts of the accelerator were used. That is general practice, and each one of these mixtures here does not represent one exepriment, but represents possibly several experiments before you got the right mixture for the purpose.

54. Q. Is there anything unusual about the formulae used aside from the accelerator used?

A. No. That formulae is an old, old formulae that we used at the Diamond in the old days and are still using at the Falls Rubber Company today.

55. Q. And in that old and common formulae you used one accelerator after another to get comparative results?

A. That is right.

56. Q. On this first page of the Norwalk Record, Exhibit "R" the first test is headed S. C. What does that S. C. stand for?

A. That stands for sulphcarbanilid.

57. Q. Then should one understand from that that the first test included two hundred parts of white para rubber, two hundred parts of zinc oxide, ten parts of sulphur and six parts of sulphocarbanilid?

A. That is right.

58. Q. A similar reference to the other formulaes would determine what experiments they represent?

A. That is right.

59. Q. For instance in the fourth column what was the accelerating substance used?

A. That would be aniline.

60. Q. Take the first column of the first row. What accelerating substance was employed there?

A. That is thiourea.

61. Q. And the next column after that?

A. That is diphenylguanidine.

62. Q. And the next column after that?

A. That is another experiment with diphenylguanidine.

63. Q. How do those two experiments differ?

A. Those differ in the same way as I mentioned a few moments ago. In trying out your substance you would not always select the right amount. I was comparing here to determine the amount of the different substances that equal a certain amount of thio, which were two well-known substances capable of general application and comparison. I thought that the d. p. g. apparently was to equal—for example in this first experiment d. p. g.-2, I evidently felt that half of it—it was about twice as strong as the thiocarbanilid marked S. C. because I only used just one-half as much. On the other hand when I actually

made those experiments I found that it was far stronger than I had anticipated. The result was that I cut the quantity down to one per cent. That involved the preparation of all of these test slabs that I mentioned, testing them and vulcanizing them at certain temperatures and so on. Then when I found that I had used too much there, I cut it down to one part, in the d. p. g.-2 experiments. I found that was too strong and finally cut it down to seven tenths of one part. In the d. p. g.-3 experiments. I finally repeated it again without the zinc oxide, which is sometimes important, because certain accelerators like thiocarbanilid react very well in the presence of zinc oxide but do not react at all or very mildly if zinc oxide is absent.

64. Q. These figures are all "parts"?

A. Those figures all represent weights.

65. Q. What do these figures represent—parts, percentage, parts by volume, parts by weight or what?

A. They all represent parts by weight.

66. Q. This duplication of the tests designated d. p. g.-3 with the same amount of d. p. g. but with no zinc oxide, is what is represented in the experiment recorded here as d. p. g.-4 is that correct?

A. That is right.

67. Q. What does the record on the next line headed d. p. g.-5 represent?

A. That represents cutting down the amount of d. p. g. from .07 grams to .5 grams. By the way I should call attention to the fact that what looks like an "f" there evidently is not. That refers to d. p. g.

68. Q. Now will you state what is recorded on the second page of this Norwalk record, Exhibit "R"

and what the relation of that record is to what is recorded on the first page?

A. The second page really summarizes, with foot notes, the results that were obtained on the first page. That is, I show here the general formulae that was used for making all of these tests with the exception of the amount of accelerator, which I left blank. Then I have taken the results that I obtained by making all of these test slabs, and forming an estimate of their quality and strength which as you see here in the case of d. p. g. involved four or five experiments, that is, four or five separate experiments and a large number of slabs and tests. I summarize that on the second page by referring back to anilin as a standard. That is, this table shows that a certain result with regard to the rate of vulcanization is obtained by using three and a half per cent. of anilin in the mixture. These are expressed in percentages and not in grams. Then with anilin at 3.5 the table shows that the same results were obtained with three per cent. dithio———, the same result was also obtained with 1½ per cent. of monophenylthiourea and with only one per cent of thiourea. Then it also shows that when we come to the guanidines that 1.75 per cent. of triphenylguanidine is equal to 3½ per cent. of aniline or that a twenty-five per cent of diphenylguanidine is equal to 3½ per cent of anilin. In other words that less of one-tenth of the amount of either mono or diphenylguanidine accomplishes the same result as is obtained by anilin. The last figure here refers to urea that I mentioned awhile ago. That figure is difficult to repeat with absolutely chemically pure urea. I prepared the urea used in this experiment by

heating amoniumcyanid and I have repeated that experiment on other occasions and I always get better results with the product I prepared than you would with C. P. Then in addition to expressing these results in the form of a table I made comments down here (Ind.) with reference to certain of them and the peculiarities of compounds as affected by the accelerator. That about summarized the second sheet.

69. Q. Is it proper to say that this table on the second page is a summary of the results recorded on the first page?

A. Yes, it certainly is.

70. Q. A summary in the form of an expression in figures of the relative accelerating values of certain substances is recorded on the first page?

A. That is right.

71. Q. From what sources did you obtain these various accelerating substances that you used in these tests?

A. I used C. P. commercially pure laboratory reagents if I had them or if I didn't have them I prepared them myself as certain of these could be obtained on the market at that time.

72. Q. What about the diphenylguanidine?

A. I prepared that myself.

73. Q. Is there anything in that Exhibit "R" that refers in any way to a preparation of that d. p. g.?

A. Yes, the third sheet dated November 3rd, gives the preparation in detail. This shows that I prepared the diphenylguanidine in accordance with the standard text book methods. There are other methods. There are other methods probably equally

as good but this method has been given in the text books for a long time, and consists in heating thiocarbanilid with alocholic ammonia, in the presence of lead oxide. The substance was separated from the lead sulphide, re-crystalized from the alcohol and finally after several re-crystalizations came out in beautiful large flat needles which melted sharply at 147 degrees centigrade.

74. Q. State what the other cases of that exhibit are referred to?

A. The next page dated November 17, 1916 showed a preparation of diphenylcyandianid. As mentioned previously there are several methods of preparing diphenylguanidine but these two that I used are both well known and known to give fairly good results with regard with the yield that you obtain in your product.

The fifth page dated November 21, refers to the preparation of diphenylguanidine from diphenylcyanid and is apparently another method which was not entirely satisfactory.

75. Q. Did others at the Norwalk plant know about this work that you were doing?

A. Dr. Russell, did, yes, sir.

76. Q. He was fully informed?

A. He was fully informed at all times.

77. Q. Did he participate to any extent in the work?

A. I believe he did. I won't say in the actual work but he was associated with me in it throughout.

78. Q. You said he was your direct superior?

A. Yes, and it was not necessary for him to participate in it.

79. Q. But he had to know what you were doing, I suppose?

A. I mean that it was not necessary for him to do any of the actual laboratory work. That was left to me and he was familiar with what I was doing all the time.

80. Q. You left the Norwalk Company when?

A. On April 1, 1917 just almost three years to the day from the time I went there.

81. Q. And independently of the dates on this Exhibit "R" can you state from recollection just when this work was done?

A. I don't believe I understand the question.

82. Q. When was this work that you have recorded on this Exhibit "R" done?

A. It was done prior to the date shown here, October 31st. Inasmuch as these experiments had to be completed before they could be written up.

83. Q. What do the dates on these sheets, Exhibit "R" indicate?

A. They extend to October 31st, November 1st, November 3rd, November 17th and November 31st. For example the reason that they extend over such a long period is that the preparation of diphenylguanidine was under investigation at that time and you will note that after these results were obtained it was desired to find some easier and better method of preparing the diphenylguanidine. That was done subsequent to the original work.

84. Q. You made out each of those sheets; you wrote what is on each of the sheets of Exhibit "R"?

A. I wrote everything on these sheets.

85. Q. Including the dates?

A. Yes, sir.

86. Q. What do the several dates on the several sheets represent?

A. As I say they represent the dates at which the experiment was written up and that means that the experiment had been concluded or completed.

87. Q. At that time was the Norwalk Company engaged in the manufacture of rubber articles for general sale?

A. Yes, they were engaged in the manufacture of automobile tires and tubes, particularly tubes. We were not making at that particular date a great number of tires.

88. Q. Were they using accelerators at that time?

A. They were using large quantities of accelerators.

89. Q. Were you familiar with the use of accelerators, the method of using accelerators?

A. As I previously stated I was not only familiar with them but I actually prepared most of them that were used in the plant, along with the assistance of Dr. Russell.

90. Q. What I want to bring out is what the connection of yourself and Dr. Russell was with the actual manufacture that went on in the factory, the actual use of accelerators in the plant, in commercial work. Were you giving time and attention to that, or were you devoting all of your time to such experimental work as is represented by Exhibit "R"?

A. Well, I devoted as much of my time as possible to work of this character, but in a small plant such as we had there we could not by the very nature

of the organization pick out any one job and stick to it. We had to fit in where we were the most useful. That meant that to a certain extent I was working on the factory compounds as well as work of this character.

91. Q. Did your work in connection with the factory end require that you should be familiar with what was going on there and the practice that was followed, the way the accelerator was used, what accelerator was used and so forth?

A. Absolutely, yes, because as I have already stated Dr. Russell and myself were the only two there. When he was away—for example, while he was on his wedding trip I necessarily had to be able to take up the work where he left off.

92. Q. How is that work generally designated, that work of the chemist in a rubber manufacturing plant?

A. I don't understand the question.

93. Q. Do the chemists of a factory have any control over the methods of procedure in the manufacture of rubber?

A. Absolutely, yes.

94. Q. And was that control in the hands of yourself and of Dr. Russell?

A. Yes.

95. Q. That was what you were doing in connection with the chemical manufacture, and in addition to that you did this experimental work?

A. Yes.

96. Q. Now you say you left the Norwalk Company in April, 1917 and went with the Falls Rubber Company of Cuyahoga Falls, Ohio. What was your

position at that time. What position did you take with the Falls Company?

A. The Falls Rubber Company had been looking about for a chemist. They had not had any laboratory or chemical supervision whatever up until the time that I went with them. Someone had recommended me to Mr. O'Donnell, our president at that time and I came on from Norwalk and looked over the plant and made them an estimate as to where a laboratory could be placed and as to the probable cost of fitting out a laboratory capable of doing general factory control and experimental work. In addition I took up the subject of my own proposition when coming with the company and after about two weeks an arrangement was finally concluded and I left the Norwalk around the first of April, 1917. I stopped off in New York on the way back to Ohio and purchased or left an order for practically half of our laboratory equipment. When I went back to the Falls Rubber Company and ordered the necessary mills and presses and so forth and had the desks made and piping, and so on, and sometime later in June we had the laboratory installed, and I had it to a point by that time so I could get an assistant and have him working around in a more or less useful fashion. That however, covered quite a period of time, in building this laboratory and getting it into operation. I went to the Falls Rubber Company for that purpose and to act as chief chemist.

97. Q. So for a time you were the entire personnel of the chemical department and then you got one assistant?

A. Yes.

98. Q. Who was that?

A. Mr. Robert L. Moore of this city.

99. Q. Did he stay with you there any considerable time?

A. No, he came shortly after college let out. He graduated from college, I believe, in June, and he came with me and was there until sometime in September, I believe. Then he left to take a position with some rubber company.

100. Q. The Mr. Moore you refer to is Mr. Moore who testified in the national suit on this Weiss patent?

A. Yes.

101. Q. Who was the next addition to the personnel?

A. There was no next addition. Mr. Moore left in September, 1917 and shortly after that I was made general superintendent of the factory, which took me away from the laboratory until Mr. Flower came. Mr. Flower, however, would not come until December 15, 1917, approximately.

102. Q. Following your entry into the employment of the Falls Rubber Company what was the next thing that was done by you in connection with the use of guanidine derivatives?

A. The next thing was the preparation of the substance itself, and subsequently its use in experimental batches of inner tube stocks.

103. Q. Will you state fully the history of that, what you did and when you did it and for what purpose, and so forth?

A. We were not at that particular time in 1917 in a position to do as elaborate work as we had done at Norwalk—

By Mr. Kennnedy:

The witness was asked to say what he did, not what he didn't do, nor to explain why he didn't do it. I should think he should be compelled to reply directly to the question. I move to strike out his answer as far as given.

By the Court:

The witness should reply as nearly as he can to the direct inquiry as put.

A. The next step was the prepartion of diphenylguanidine in the laboratory by myself as Mr. Moore was without sufficient experience to be put upon work of that character. Later on it was desired to test those substances out in inner tube stocks and at that time we had a particular stock that we had made up hoping to obtain an order from a friend of mine who bought tubes in large quantities. In fact I had had considerable telephone conversations with him and the only thing that stood between us was price. The result was that we worked out a stock that met with his approval and on which we could make him a satisfactory price, and obtained an order for a thousand tubes which he needed at that time. We had this stock worked out in the laboratory and later on when the order was actually entered and while it was being mixed I saw to it that a portion of the D. P. G. which I had prepared in the laboratory was used in some of these tubes. I did not, however, have enough of the diphenylguanidine to use in all of the tubes. I used what I had and then left the formulae go through the factory in the regular way, in which it was finally allowed to remain there.

104. Q. This supply of diphenylguanidine that you had yourself made at the Falls plant before this order came up?

A. Yes. I wouldn't say how far before the order came up, but it was made prior to the order.

105. Q. State by whom this order was given, who was it bought these tubes?

A. The Rubber City Clearing House.

106. Q. That concern was run by whom?

A. Mr. Charles E. Williams.

107. Q. That is the man you referred to as a friend of yours?

A. Yes.

108. Q. And you yourself took the order?

A. I took the order, yes, sir.

109. Q. Did you have to report that order to anybody to get approval on it?

A. Yes. I took the order by telephone and wrote it up on our regular order memo. and that had to be O. K.'d for credit and subsequently billed out on our regular shipping order.

110. Q. Do you do something by way of referring it for credit?

A. My original pencil memo. was referred to Mr. M. J. O'Donnell our president and as I remember it he O. K.'d the order and it was then turned over to the billing department, who made out the formal copy and turned one copy over to the factory, I imagine and the other stayed in their own department.

11. Q. Now I understand that this order was for one thousand tubes and that in the manufacture of some portion of these D. P. G. was used as

an accelerator. I wish you would state in detail the steps that you went through leading up to the manufacture of these tubes and what you did and the sequence of events, and why you did it?

By Mr. Wooster:

I object to that question as the witness stated he did not manufacture the tubes. He said he saw to it that some accelerator previously made by him was put into the batches.

By Mr. Edmonds:

112. Q. Will you limit your answer to what you did or had done under your direct supervision?

A. You are speaking now with reference to the preparation of these particular tubes in the factory.

113. Q. Yes, and the work done by you that led up to the preparation of the tubes in the factory?

A. Well, I should do that first.

114. Q. Please do that first?

A. The work leading up to it was done in this way. As I mentioned a few moments ago we were bidding on this order for this particular gentleman and it was required to work out a formula that would meet with his approval as far as quality went, and at the same time permit us to make him a price that would be consistent with good business. We made up three compounds as I remember it in the laboratory one of which was selected for factory practice in case that we should get this order. These were recorded on a sheet of paper in a laboratory note book. The note book sheet, however, is not the sheet that was taken to the factory. That is not our

practice. At the Falls Rubber Company we have been in the habit of using note book sheets very similar to this Exhibit "R" on which we would write up our additional notes in reference to the experiments that are carried on. Some of those are failures and some of them are subsequently put into the factory. Those that are put into the factory are always written up on a separate card, with us. That is, we do not turn a sheet like this or like what was produced in the Aniline trial, over to the factory. That represents my personal laboratory notation of the record.

115. Q. This sheet that I hand you now is the sheet that you have just referred to as having been made up in the laboratory?

A. That is the laboratory sheet, yes, sir.

116. Q. Is that in your handwriting?

A. Yes, sir.

117. Q. When was that sheet prepared by you?

A. This sheet was prepared by me—that is it was written up on August 25, 1917 but as I have already said the work that was done there preceded the actual writing up of the results.

118. Q. Where has this sheet been after you were through with it at that time in 1917 and until it was gotten out for use in this accelerator litigation?

A. That was in the files of the Falls Rubber Company.

119. Q. It was gotten out for this purpose by whom?

A. I don't remember by whom. It was gotten out for this purpose. It was gotten out by myself

originally from the files and then turned over to yourself or Mr. Barrows.

By Mr. Edmonds:

The papers just referred to by the witness is offered in evidence as defendant's Exhibit "S".

By Mr. Edmonds:

120. Q. Now, will you continue with your answer to the previous question?

A. This record here is our laboratory record of the experiments that were carried on in the preparation of the general type tube stock that was used for these tubes which were sold to the Rubber City Clearing House. On here it is stated that No. 63—modified was called T-8. T-8 is a factory compound that was used, or was at that time but that has nothing to do with this particular sheet here. That is, we called No. 63-modified, T No. 8 but T-8 was written out on a separate card, and this particular sheet never left the laboratory, which in this case meant my own personal note book. You will note on this sheet that T-8—the form for it—is represented by No. 63 modified. That represents the formula which was put into the factory. You will also see a notation there with regards to No. 63, with a square around it and over to the side in pencil two notations "Lagos B-2.0;" another M or diphenylguanidine, 0.2. These refer to personal notations of myself with reference to the substitution of something else manylnose rubber, which was an accelerator we used at that time. The original formulae there had one portion of the manylnose rubber in it. I felt as though that one manylnose rubber equalled certain

amounts of other accelerators. This notation here with regard to Lagos represents the old factory name for thiocarbanilid. The M or diphenylguandine represent diphenylguanidine, and the diphenylguanidine is shown there on this pencil notation to be exactly one-tenth the amount of the thiocarbanilid. This ratio I should explain with thiocarbanilid is the amount to be used in tube stocks or in other stocks, is well known to all chemists and was known to me at that time and for a long time prior to it. When the tubes were actually made up in the factory they were made up—I am now speaking of the Williams tubes for the Rubber City Clearing House—they were made up under T No. 8 which you will see here is the same as No. 63 except that a portion of magnesia was removed and for it was substituted the diphenylguanidine that is, one had the diphenylguanidine that I had prepared myself and I substituted it for a portion of magnesia in the T-8 formulae. These compounds here as shown by this sheet, the laboratory sheet, I probably mixed those myself on the tubes that were prepared in the factory by the Rubber City Clearing House. I supervised that. I didn't actually mix the batch but I made the substitution, that is, instructed the man who did the weighing, whoever he might be, to simply weigh out a lesser portion of magnesia and I substituted the diphenylguanidine myself as long as it lasted. Then the T-8 stood as it originally was in the factory.

121. Q. Referring to this Exhibit "S" there are three formulas there which seem to be designated 62, 63 and 63-mod. Are we to understand that first formula was in use at all in commercial work?

A. No, I don't think that was used at all, the way this sheet shows. There is no notation with regard to No. 62. No. 63 was tried and was found to be more satisfactory than No. 62. No. 63 was then followed by No. 63-mod. or modified.

122. Q. 63 just as it stands, has one part of mannose. Was that an accelerator?

A. That was an accelerator, yes.

123. Q. And also had one part of magnesia. Was that an accelerator?

A. Yes. Magnesia is a very active accelerator particularly when used in connection with an organic accelerator. The two function together. I was familiar with that as is shown by my papers that are previously published, and I have actually applied in these tubes the same principles which I wrote of in some of these papers.

124. Q. Now the only difference is in 63 and 63-mod. just as they are written there is that 63-mod. has no mannose in it and it has three times as much magnesia?

A. That is right.

125. Q. Will you state again exactly what formulae was used in the manufacture of these tubes for the Rubber City Clearing House? That is state that by reference to these Nos. 63 and 63-mod. and the extent to which each was used?

A. The formula actually used in the factory for these tubes and subsequently for certain other tubes was No. 63-mod. which was called factory T-8. In the case of the Williams tubes, however, I substituted the magnesia with this ratio of d. p. g. as long as my d. p. g. lasted. That figured out in accordance with these figures here.

126. Q. Then in those tubes that were made which had the d. p. g. in you used .02 parts of d. p. g.?

A. Yes. It figures out on the ratio of .2 on the slab of rubber, and reclaimed rubber.

127. Q. That is .02 per cent.?

A. No, that is the weight. That is grams.

128. Q. .2 by weight?

A. Yes.

129. Q. When you used that .2 grams of d. p. g. did you use any magnesia?

A. Oh, yes, there was some used.

130. Q. How much?

A. I can't say as to that off hand. It will figure out probably using this figure, about one or one and a half.

131. Q. It would be one part, whatever percentage that represents?

A. I don't understand.

132. Q. One part of this total of 560; that is how much was the magnesia? The formula gives 63 and I understand you used a less amount of magnesia, when you used the d. p. g.?

A. Yes.

133. Q. How much less?

A. That would figure out about one part or one and a half parts.

134. Q. To what extent did your d. p. g. last. How many tubes were made with your d. p. g.?

A. I cannot answer that accurately, owing to the fact that I do not know exactly how much d. p. g. I had. I believe, however, that approximately 300 tubes would probably be as good an estimate as I could make. That is 300 out of the thousand that

were prepared for the Rubber City Clearing House. When that was exhausted the remainder of the tubes were made after formulae T-63 which in the factory was called T-8

135. Q. And that began when the suppiy of d. p. g. which you had was exhausted?

A. Yes.

136. Q. Can you tell how you arrive at this figure that you have written out here for thio, this figure of 2.0 for thio.?

A. We all knew how much thio it would take to obtain certain results and that is the reason why we knew approximately how much thio it would take, and my previous work had shown me that d. p. g. was ten times as strong as thio, so it was evident that if I should have to use two of thio, as I thought I would only have to use two-tenths of d. p. g.

137. Q. And the selection of two parts of thio. then was a matter of experience and judgment?

A. Absolutely, yes, sir.

138. Q. What is the document I now hand you?

A. This is the original memo. of the order that I made out for these tubes for the Rubber City Clearing House.

139. Q. In part that is your handwriting?

A. In part this is my handwriting, yes.

140. Q. Do you recognize the O. K. on there?

A. I do, yes, sir. That is the O. K. of our president, Mr. M. J. O'Donnell.

141. Q. Is that the O. K. for credit that you referred to awhile ago?

A. Yes. That was really in Mr. O'Donnell's

capacity. That should be a general O. K. for credit and shipment and everything else.

142. Q. That date September 4, 1917 was put on there by you?

A. Yes, sir.

143. Q. "Gray tubes" that was written by you?

A. Yes, sir.

144. Q. What are the two documents that I hand you?

A. According to our procedure at the factory at that time and to a certain extent today, orders given over the telephone or in person, other than a salesman, are taken down on a memo pad, of the same type that you have there. Those orders are then given to the necessary parties for O. K. and credit, or shipment of any kind and then when properly O. K.'d are turned over to our order department which makes out a formal shipping order of this character. These two orders, A-12546 and A-1284 are the shipping order formally issued after I turned in the properly O. K.'d memo.

145. Q. In one of the upper corners of this document 12546 appears "Memo Kratz." What does that mean?

A. That means that this order was formally issued on my memo which you have there.

146. Q. From where did these three papers come?

A. These three papers were produced from the files of the Falls Rubber Company at the time of the aniline case.

By Mr. Edmonds:

These three sheets referred to by the witness in connection with the sale of one thousand tubes to the Rubber City Clearing House are offered in evidence to be marked collectively Exhibit "T."

By Mr. Edmonds:

147. Q. Can you state what the paper that I now hand you is?

A. Yes. That represents the physical test results of a stock made up under the formula T-63 shown on the sheet that records my laboratory experiments.

148. Q. Is this another document from the files of the Falls Rubber Company?

A. It is.

By Mr. Edmonds:

The paper identified by the witness is offered in evidence as defendant's Exhibit "U."

By Mr. Edmonds:

149. Q. Do you know of your own knowledge whether or not these one thousand tubes were delivered?

A. Yes, sir. That is the tubes were actually shipped to this gentleman and sold by him.

150. Q. To the best of your knowledge and belief or to the extent of any knowledge that you have, were they satisfactory?

A. Yes, he so told me.

151. Q. Coming back for a minute to the manufacture of these tubes and the D. P. G. that was

used in certain of them, I understand you to say you put it there yourself, is that correct?

A. Yes. I put it there in this way. The only substance that was required to be altered in the T.-8 formula was the magnesia. The factory compound man made up this formula, put up the batch as we call it, in the regular way but I simply told him to put in a lesser amount of magnesia in these batches, and then added the D. P. G. to the mixture myself. On the factory batches, while I supervised them the actual work that I did consisted of putting the D. P. G. in the mixture.

152. Q. What I am getting at is this, who if anybody knew that you had put D. P. G. into that batch?

A. Not a soul, not a soul knew it. They simply knew that I was putting some white substance in there.

By Mr. Kennedy:

Why can't this witness answer the question asked. In every case he diverges from it and loses time that I assume is valuable. I move to strike out the last answer.

By the Court:

Go on. Of course declarations of others perhaps are not evidence of their particular knowledge. The actual fact that would be shown there would be that he did not disclose to any person the nature of the particular substance he was putting in.

By Mr. Edmonds:

The sole purpose is to let anyone who is interested know.

By Mr. Edmonds:

153. Q. There has been some discussion of a paper written by you in September, 1919. Will you state whether or not the document that I now hand you is a paper prepared by you and your associates and if so state when and where you presented that paper to the public, being Exhibit "E?"

A. This paper, Exhibit "E" was written by myself and Mr. Flower and Mr. Coolidge covering certain work that was done at the Falls Rubber Company, and put in the form of a paper and presented by me at the Philadelphia meeting of the American Chemical Society in September of 1919. Subsequently it was published in the journal of Industrial and Engineering Chemistry.

154. Q. You say it was presented. You read the paper before a meeting there in September, 1919?

A. Yes, sir, I did.

155. Q. There has been something said about posting some parts of this on the blackboard. What is your recollection in connection with that?

A. The tables of this paper were placed on a blackboard, to be used in presenting the paper and I put on as much of them as I could inasmuch as there were already some figures on the blackboard either for the past paper or the paper to come. The larger portion of the tables or the summaries were put on the blackboard.

156. Q. Specifically table 1 and table 2 on page 13, were they or parts of them put on the blackboard?

A. No. As I remember it both of those tables were on completely.

157. Q. What, if any, is the correspondence between tables 1 and 2 that I have just referred to, and the information on the second sheet of the Norwalk report, Exhibit "R"?

By Mr. Kennedy:

Objected to on the ground of indefiniteness. I don't know but maybe the witness knows what counsel means by "Information" when he asks for a comparison of the two tables. The tables speak for themselves.

By the Court:

The objection is overruled.

A. The tables show the relative accelerating action of the different substances when used for this purpose. In the case of the Norwalk work however, that is shown on the second page here, dated November 1st. That refers to work done with a mixture containing zinc oxide. The work shown in this paper was done with a mixture without zinc oxide. That does not seem to make any particular difference in the case of diphenylguanidine but did made a difference in the activity of some of the other accelerators such as thiocarbanilid.

158. Q. State what work you did in testing these accelerators covered by tables 1 and 2, without zinc oxide and when and where you did it?

A. This work here without zinc oxide as represented by the tables shown in Exhibit "E" were practically all done at the Falls Rubber Company and covered a considerable period of time. You will note that there are no physical tests in these

experiments and that the results were all carried on, as I previously outlined by vulcanizing slabs and using the thumb and tooth test, simply to check up that there were no unusual discrepancies between the use of zinc in the formula and without zinc in the formula.

159. Q. Will you state the circumstances under which you came to prepare and present this paper, Exhibit "E?"

A. This paper was prepared after attending a meeting of the American Chemical Society, in Cleveland where I read a paper with Mr. Flower on the vulcanization of rubber at a constant temperature and with a series of increasing temperatures. That meeting which was in the fall of 1918 was quite largely attended due chiefly to the announcement that there was to be a symposium on accelerators led by Mr. George Oenslager, of the Goodrich or Diamond Rubber Company. At this symposium when it was called we all expected to hear a great deal about accelerators and as the proceding went on there was absolutely nothing said. As a matter of fact everyone sat there waiting for someone else to talk. So I felt after that meeting that it was time someone should put some actual data on accelerators into a publication and I talked that over with Mr. Flower and we decided that we should put some of our information into the form of a paper to be presented at the next meeting of the American Chemical Society.

CROSS-EXAMINATION.

By Mr. Wooster:

X160. Q. How long have you been vice president of the Falls Rubber Company?

A. Since our last annual meeting in January.

X161. Q. You succeeded Mr. M. J. O'Donnell whom you mentioned?

A. No, sir. Under our present arrangement both Mr. M. J. O'Donnell and I are vice presidents, but Mr. O'Donnell is no longer active with the company other than as a director.

X162. Q. You referred to naphthylguanidine. What kind of a substance is that?

A. Dipnaphthylguanidine.

X163. Q. Is that tri-substituted or a di-substituted, or a mono-substituted or a tetra-substituted guanidine?

A. I couldn't say, sir.

X164. Q. Coming to the tubes at the Falls Rubber Company can you recall any other formulas which were in use in the factory at the time you were there? Not the contents of the formulas but the factory names of them similar to the one you mentioned as T-8?

A. Yes, I can recall them because I named them.

X165. Q. Will you give some of the other names?

A. Well, there was T-3; T-4; T-5; I believe T-6 and T-15.

X166. Q. When did T-8 become a factory compound?

A. T-8 became a factory compound some time

in September, 1917. Please understand that that refers to a compound like T-8 where it was used on special or private brand orders, as this order was for a thousand tubes. That formula is not necessarily in use from day to day, like our tread stock.

X167. Q. Was T-8 formula only used for special orders or was it a standard gray tube formula that was used right along?

A. As I remember it we didn't make any grey tubes in those days. We made only red and green.

X168. Q. You had other code names for red and green tube formulas?

A. No. There was for example T-5 and 6. For red tubes. The code name would not indicate the color of the tube.

X169. Q. Was T-15 for a green tube?

A. Yes.

X170. Q. Why not T-8 for a grey tube?

A. T-8 was a grey tube.

X171. Q. But you say it was only a grey tube made for a special order?

A. No, I said we were making only red and green tubes in the factory at that time. In fact it was only within the last few years that we have made any great drive on grey tubes. This man wanted a grey tube.

X172. Q. He was the first man that had wanted grey tubes, is that right?

A. No, by no means.

X173. Q. Was he the first man to whom you sold grey tubes?

A. I couldn't say as to that.

X174. Q. Is it not your best recollection that you had sold grey tubes previous to taking this order from the Williams concern?

A. I don't understand your question. You mean had we ever sold grey tubes before.

X175. Q. Yes.

A. Most assuredly yes, but when I came to the Falls Rubber Company, in April, 1917 their tube department was shut down. Their tubes had been unsatisfactory and they decided they would not make any more tubes until they had one that was right. That was part of my duties in going there.

X176. Q. Does this mean green tubes or red tubes or grey tubes or all three?

A. All three. They made no tubes when I went there in 1917, in April.

X177. Q. But they had the equipment to make them?

A. They had part of the equipment.

X178. Q. What part didn't they have?

A. They didn't have the necessary splicing mandrels, nor the right size mandrels on which to make the tubes. In fact all of the equipment was old and obsolete and one of my first duties was to order new equipment.

X179. Q. But it was possible with the equipment you found there when you went to make tubes, was it not?

A. They had done it but the tubes were not satisfactory.

X180. Q. Were the tubes unsatisfactory because of the equipment or because of improper compounds?

A. I have no idea. That was before my time.

X181. Q. What did you do with tubes after you got there? What was the first thing you did?

A. The first thing I did was, of course, to bring our equipment up to date and procure the right size mandrels, splicing mandrels, and we arranged the room and so on. Then I brought out a red tube which was sold to some extent although naturally not having been in production for sometime our sales on tubes, at least, were not large. Shortly after we got into the manufacture of tubes I brought out the Evergreen tube, which particularly appealed to our president, Mr. O'Donnell, and later on we specialized in that tube in the Evergreen, and we do to this day.

X182. Q. Do you recall when the Evergreen came out?

A. You mean when the first Evergreen tube was made?

X183. Q. When it was first marketed?

A. I have copies of the first advertisement describing it.

X184. Q. What is your best recollection?

A. I wouldn't have any recollection.

X185. Q. Will you explain how a tube is made, the various operations?

A. All the way through?

X186. Q. Yes.

A. Starting back with the raw rubber, the rubber and the different ingredients are usually kept in separate rooms under the supervision of a man we call a compound man. These ingredients are weighed out in ordinary practice. What we did at Falls was to bring our rubber into our compound room where

we have two or three men who tear down the rubber. By tearing it down I mean that the rubber is in sheets closely pressed together. These have to be torn apart. Then we have always held them up to the light for inspection. This means that we have two or three men engaged in that work. We also have one man who is engaged in sifting pigments, a machine I built about that time, 1917 or had built for me for the sifting of the pigments such as zinc oxide and so on to keep the splinters from getting into the stock. There is also a man to weigh out the different substances and a man to assist him. In the compounding room—I cannot say definitely what it was in 1917 but there must have been at least three to five men working in that room. Today we have possibly ten to fifteen men. The batches are put up in this fashion, that is, after the materials are brought to the man who does the weighing he weighs them out and puts them in a pan or bin where it is carried to the mill on which it is mixed. The rubber is put on there and is allowed to soften and the different pigments are put into it from time to time as fast as they can without dropping through. After the stock is all mixed up in that fashion it goes to the calendar, and is sheeted out in the proper form, a flat sheet, from which it goes to the tube room and is cut up into flat pieces of stock which are rolled around a mandrel, vulcanized The end of the mandrel is spliced, a valve inserted and so on.

X187. Q. Is this cure of tubes wrapped on a mandrel, what people call an open cure or what has been previously referred to as a press cure? If it is an open cure will you describe it?

A. It is an open steam cure. It is a case where you simply take a piece of rubber and wrap it around a hollow mandrel and then wrap the rubber after it is rolled up, wrap it down with a wet rag, which gives a certain amount of pressure, and it is put into a vulcanizer and live steam.

RECESS.

AFTERNOON SESSION.

Tuesday, October 13, 1925.

G. D. KRATZ, recalled, testified as follows:

CROSS-EXAMINATION (Continued).

By Mr. Wooster:

X188. Q. At the time of recess you were explaining the progress of tubes through the plant, and had, as I recall, just stated that the tubes were cured in open steam after being wrapped in cloth. How many men did this?

A. That would take a number of men. I don't believe I could say offhand. It would take a man to roll the tubes on the mandrel, and another man to wrap them, and two or three more men to put them in the vulcanizer, the man who took them off the pole and a man to splice them. There would be several operations—there would be a number of operations all the way through.

X189. Q. After the tubes were stripped off the mandrel they were then turned inside out to bring

the cloth marks inside, and then spliced, giving the smooth outside appearance to the tube?

A. That is the way we have always cured tubes.

X190. Q. Well, that is the customary way, isn't it?

A. That is customary, with one or two exceptions—in those days.

X191. Q. What then happened to the tubes after they were spliced?

A. After they were spliced they were inspected and put up in the regular box to ship out, in the regular way.

X192. Q. And when were the valves put in?

A. The valves were put in—I couldn't say at that particular time when the valve was put in. At present we put the valve in just before splicing the tube.

X193. Q. Now this is the general procedure that was followed with those tubes made on the 63 formula, is it?

A. Well, it is the general procedure followed for making of tubes made under T-8, which was based on the 63 formula, yes sir.

X194. Q. I mean, there was no special variation in the regular procedure in filling this order for Rubber City Clearing House, was there?

A. Only the addition of the D. P. G. to the mixture by myself at the time it went on the mill. That was the only part I played in this all the way through, in the factory.

X195. Q. You said there were one or two men that did the milling?

A. No, only one man did the milling.

X196. Q. Who was he, doing the milling when you put this D. P. G. into the batch?

A. I would have no idea as to who that might be. We employed anyone who was an experienced mill man. At that time we had quite a few foreigners. You see, we have five mills.

X197. Q. All in one room?

A. No, sir.

X198. Q. Which room was this Rubber City Clearing House order made in?

A. Well, all tube stocks and finished stocks that are subject to discoloration are milled in our regular mill room. You take stocks that contain a large percentage of gas black, like tread stocks, they have to be prepared in a special room. We had such a room at that time as I remember.

X199. Q. Will you state just in which room this order for Rubber City Clearing House was milled?

A. I guess it was milled in our regular mill room—not the basement, but the mill room.

X200. Q. That was the room where you milled tread stocks and other tube stocks?

A. Not tread stocks, no, sir.

X201. Q. Where you milled only tube stocks?

A. No, where we milled virtually everything except tread stocks and bead stocks.

X202. Q. The same room where you made the evergreen tubes?

A. Yes, sir.

X203. Q. The same room where you made the red tubes?

A. Yes, sir.

X204. Q. And will you give the names of the men who were present when you put this D. P. G. into the batch?

A. I can't do that because they were just our factory workmen, and it will be impossible for me to say that any of them are still in our employ—at least in the mill room.

X205. Q. Will you give the names of the men who were employed in this room at the time you say you put this D. P. G. into the tube batch?

A. I couldn't very well do that because many of them are foreign names, that I probably didn't know except by Bill or Mike or Steve, some name like that.

X206. Q. Can you give the name of the man you said was the compounder at this time?

A. Well, as I remember it, we had possibly two or three employed in the compound room, and as I previously stated, in that room in connection with the putting up of batches there were possibly five men. The only one I can remember off hand of being employed there was Paul Shaw, and I don't remember him as being employed there for all of this time.

X207. Q. You mean the Mr. Paul Shaw who is here present?

A. I do, yes, sir.

X208. Q. What was his position?

A. His position was compound man, I guess you would call him.

X209. Q. Did the compound man have charge of the raw materials, and was he held responsible to the management for what became of them?

A. For the raw materials?

X210. Q. Yes, the raw rubber and other materials that went into the batch?

A. Certainly not.

X211. Q. Well, who was responsible for the stock—what you might call the stock clerk?

A. If you speak of raw materials, the stores man, stores keeper—or in our case, he is a joint—he has a joint capacity of store keeper and receiving room clerk.

X212. Q. Well, who was he at this time?

A. That I would have no idea.

X213. Q. Well, whose job was it to get the necessary materials from this storekeeper in order to fill this Rubber City Clearing House order?

A. Well, whoever was in the compound room could get the necessary materials from the storekeeper by ordinary requisition—that is, any signed requisition for materials, raw rubber, zinc oxide, any other material, on being taken over to the store keeper was evidence that it could be delivered to the person that presented the order.

X214. Q. You did not yourself go personally to the storekeeper and get the materials for this Rubber City Clearing House order, did you?

A. I would certainly think not.

X215. Q. Well, did you make out any requisition or other paper by which anybody else could have gotten the materials from the store keeper?

A. Did I personally?

X216. Q. Yes.

A. I wouldn't think so. Any order for the Rubber City Clearing House or anyone else should go

through in the regular way, and that did not require a special order from me.

X217. Q. The regular way was to put orders through without anything from you, was it not?

A. As far as the regular operations of putting an order through, I was not concerned in that. The only thing I was concerned in was the nature of the materials that went into the order, that is, if I wished to alter a certain formula, that was my privilege. As an example—and one that is frequently in use, or was in those days—you run out of one type of rubber, and you substitute another rubber for it. That is absolutely up to the chemist, whoever he is.

X218. Q. Is that not up to the compounder?

A. Absolutely not, no, sir.

X219. Q. Can't the compounder substitute crepe or smoked sheet for each other?

A. Unless he has instructions from the chief chemist he is absolutely violating our rules.

X220. Q. Who would have made out the requisition for materials to fill this Rubber City Clearing House order?

A. I don't see how anybody would have made it out. When putting through a requisition for materials for raw rubber, for example, it would be put through for a ton, or whatever quantity would go on the right kind of truck to haul it away from the store room and that rubber would be used on whatever orders would go through the factory at that particular time. If it happened to be green tubes, part of it might be used in that, and the balance in gray tubes or red tubes, or tires. I don't see how there could

be any possible traces of the Rubber City order or any other order that has gone through our factory.

X221. Q. But you say you took by telephone an order from Rubber City Clearing House for 1000 tubes of assorted sizes, these to be gray tubes, at a special price. Now, what was the next thing that happened on that order, and who did it?

A. Well, all that was necessary there was to put the results of the experimental work, as shown on one of those sheets this morning—put the 62 or 63 or 63 Modified experiments on it, convert those experimental results into a form that could be turned over to the factory, and give it to the compound man, or whoever was in charge of the work, to put up the batch. He put it up, he didn't know whether it was going in the Rubber City Clearing House or going in the Falls Tire; if he did he got it from other outside sources.

X222. Q. But you have not yet said who made out the requisition?

A. I have already said there could not have been any requisition for materials for that order—which is the way I understood your question.

X223. Q. You mean the compound man got something from you—

A. He got a card.

X224. Q. In the way of a formula?

A. Yes, sir.

X225. Q. And then he told the storekeeper to give him some rubber, and brown sub, and blank fixe and mannose R, No. 40, and magnesia, and the store house man did it. Is that right?

A. If he was short in those substances that you

mention from his own room, yes, he got that from the storekeeper, but he would have the greater portion of those things—of the different substances right in his own compound room. That is why I say you can't trace any particular order.

X226. Q. And the compound man kept no record of what he used up out of his own stores, nor charged those things against particular orders. Is that right?

A. I can't say as to the compound room man charging or being held responsible there. I don't believe that was his capacity. We have always held the stores man responsible for deliveries.

X227. Q. But you figured out the cost of these tubes, and how could you do it until you knew just how much of each ingredient was used?

A. I knew that from my laboratory experiments.

X228. Q. What was the total weight of these tubes furnished on the Rubber City Clearing House order?

A. The total weight of the tubes themselves furnished on the order?

X229. Q. Yes.

A. I couldn't say as to that. Probably it was —a thousand tubes of assorted sizes, somewhere around 1500 pounds.

X230. Q. 1500 to 2000 pounds?

A. Possibly, yes.

X231. Q. And you haven't a single record of where more or less a ton of material came from to fill that order, have you?

A. We certainly have, but I would't see where that would be in the compound room. I am saying

that the record was kept by the stores man. It was a case of charging it out rather than charging it back. We keep a perpetual inventory in our stores. Whenever the stores man gets in a car load of rubber, he weighs it up. When the compound man comes to him and takes a truckful of the rubber away, the rubber is weighed and deducted from our perpetual inventory and charged against compound.

X232. Q. How could the stores man, according to that system, have any record of what actually went into this Rubber City Clearing House order, and how much it cost?

A. Well, the stores man is not concerned with how much the Rubber City Clearing House order cost. We know for example that our rubber for the month of September, 1917, or September, 1925, costs us so much. That rubber—the average is turned over to whoever has occasion to use it, such as your chemist, your compound man, your tire construction man. He employs that cost for the month of September. If the average cost of our rubber in October is greater or less than that amount, he revises his figures accordingly.

X223. Q. From that do I understand that the costs given on columns No. 62, No. 63 and No. 63 Modified are simply estimates of monthly costs for that month?

A. Well, they are the batch costs. For example, —I have forgotten the cost of rubber at that particular time, but it was somewhere between 50 and 60 cents a pound. We knew exactly how much our average cost of the different ingredients was at that par-

ticular time. Those were supplied to me in the laboratory by our purchasing agent. They were also supplied to our cost man. So far as I know we were the only two that were interested in them. I was only interested in them to the extent of making up a compound here which would permit us to bid against somebody else and obtain the order from the Rubber City Clearing House. They had previously bought these tubes from someone else.

X234. Q. Well, your pencil memorandum of September 4, 1917, says: "Price 50 plus 5 percent Miller list." Will you explain what that is?

A. Isn't that 50 minus 5—or 50 and 5?

235. Q. It is 50 and 5, exhibit T, National record, page 502.

A. This price 50 and 5 percent off Miller list, that meant that the price at which this order was taken was at a discount of 50 and 5 percent off of the current list of the Miller Rubber Company. We had been asked to make tubes—rather I had solicited his tubes. He said that he would be willing to give us a preference provided we could give a tube equal in appearance to what he was buying and at approximately the same price. I had duplicated the tube to all external appearances, to satisfy him. The tube that was furnished against this order was equal to or better than the tube that he had been buying, as judged by external appearances, and in accordance with his estimate of quality.

By Mr. Wooster:

I move to strike that answer out as irresponsive and volunteered. My question simply related to the price.

By the Court :

It seems to me you are taking altogether too much time with this phase of it—as I understand the particular purpose, because after all you are going to come squarely up against the original proposition to the effect that he imparted to no one particular person the stuff he put in the compound.

By Mr. Edmonds:

But the answer is not irresponsive. It was a direct answer to the question asked him.

By the Court:

Well, I will not strike it out. As I understand—the question of time is the thing that was worrying me, and it seems to be out of proportion, the matter of time being taken up.

By Mr. Wooster:

I would like to say this is really the crux of the case, and we deem it most important that this transaction as given by this witness this morning be very fully disclosed here.

By the Court:

Well, you are going over the thing and repeating, after the same question has been put. Go ahead however.

X236. Q. Referring now to formula 63, I understood you to say this morning that Mannose R was an organic accelerator, is that right?

A. That is right.

X237. Q. Was that hexamethylenetetramine?

A. I would't care to commit myself in that respect, inasmuch as we are still using the substance.

X238. Q. Do you know what it was?

A. I believe I do, yes.

X239. Q. You will not say it was hexamethylenetetramine?

A. No. As I say, I wouldn't care to commit myself, inasmuch as we are still using that substance, practically.

X240. Q. Was it all accelerator, or a mixture of rubber and accelerator, what is sometimes called a master batch?

A. It was a master batch.

X241. Q. What connects this formula No. 63 with the pencil order you took, dated September 4, 1917?

A. Nothing, except as I just explained—this tube was in anticipation of this very type of order we were getting, on price. This tube was designed to meet the very emergency presented by this order.

X242. Q. Yes, but the price of No. 63 is the same as the price of 63 Modified?

A. That is right. As a matter of fact, 62, 63 and 63 Modified are all so close in price that, so far as it was concerned, any one of the three could have been used on this order.

X243. Q. Exactly. Now what connects this order with the substitution you stated this morning in No. 63?

A. That question isn't clear.

X244. Q. You said this morning that you substituted diphenylguanidine in formula 63 for mannose R. I now ask what connects that substitution, if and

when you made it, with this Rubber City Clearing House order of September 4, 1917?

A. Well, as explained this morning, I knew the relative activity of mannose R, lagos P, and diphenylguanidine. To me any one of those three substances was interchangeable in the quantity shown, but I wanted to try the diphenylguanidine in practice. That was the reason that substitution was made.

X245. Q. And that is the substitution that you told no one about, isn't it?

A. Yes, sir. I had no one to tell.

X246. Q. What enables you to say that you used .2 parts of diphig instead of M. or monophenylguanidine?

A. Well, I have never been able to have any great quantity of monophenylguanidine. In fact, it is, as I remember it, more difficult to prepare, and get pure.

X247. Q. Is there anything in this entry referring to lagos P. and M. or diphig, which shows which of these three materials was actually substituted?

A. No, I wouldn't think so.

X248. Q. That is, you can't tell from this entry on the sheet which was actually substituted?

A. No. These are my personal notations there —you couldn't.

X249. Q. And the square in column 63 opposite mannose R is the only thing that tells you in which of the three formulas the substitution was made. Is that right?

A. Well, that is virtually right, yes. But you will note that 63 and 63 Modified are identical, with

the exception of the mannose and the magnesia. Now, substituting anything else for mannose will substitute —or will result in substituting a lesser or larger amount of magnesia. No. 63 and No. 63 Modified, to my way of thinking, as a chemist, represent the same formula. It is simply a modification of the formula in connection with the accelerator used.

X250. Q. To put it in my language, the one part of magnesia and the one part of mannose R in No. 63 equal or replace the three parts of magnesia in No. 63 Modified?

A. That was what I believed.

X251. Q. Is that it?

A. That was what I believed, but apparently it was not true. You will note at the bottom of that page it says, "No. 63 bloomed out well on even 60 by 40 cure." In other words, that compound was probably undercured.

X252. Q. You mean No. 63 was probably undercured?

A. Yes, sir. No. 63 as it stands there. That is, with the mannose R in it. I make that statement because the tube formulas—or the tubes cured in open steam were cured at 35 minutes by 40 pounds.

X253. Q. Did you say this morning which of formulas 63 and 63 Modified the substitution occurred in?

A. Well, as I just stated a few moments ago, to my way of reasoning, as a chemist, 63 and 63 Modified are the same formula. In substituting D. P. G. for mannose R, I necessarily had to alter the amount of magnesia. Those are the only two variants in those two formulas. There is another point that possibly

should be brought out and that is that in converting this in the factory on a hundred pound batch, such as I described previously, you cannot always transpose figures like 3 and 5 on 560 total mass,—it is difficult to transpose those exactly to pounds and ounces.

X254. Q. It is still not clear to me whether in the tubes of the Rubber City Clearing House you used three parts of magnesia, as in No. 63 Modified, or one part, as in No. 63, together with D. P. G.

A. Well, it would figure out one part plus the D. P. G. Then when the D. P. G. was exhausted it was necessary to go back to three of magnesia, and that formula did not give us good results as with the D. P. G.

X255. Q. Well, when you went back to the three magnesia, that became No. 63 modified, didn't it?

A. That is right.

X256. Q. And that was the T-8 factory formula, wasn't it?

A. Yes,—because I had no more D. P. G.

X257. Q. You said you put the D. P. G. into this batch in the mill room. Did you put it in all at once, or how did you put it in?

A. No. In trying out anything like that, which I did on a number of occasions, not only with D. P. G., but with other substances, any of which are dry powders, they were taken and put on a piece of paper, in this fashion (ind.), and spread along here if this was the revolving roll, with the rubber going around it,—it was held this way (ind.), with the paper slightly inclined, and that gradually absorbed the material that you were putting into the stock, that is, the vi-

bration of the roll knocked the material off the paper. Of course, here I am working down with exceedingly small quantities, as I find in my papers. We were interested in small quantities, and it took a great deal of care in getting that into the rubber.

X258. Q. How much D. P. G. did you have to work with?

A. It was somewhere around 30 grams.

X259. Q. 20 to 30, as you said in the National case?

A. Well, as I said there, I couldn't commit myself on that. At that particular time they presented me with a small bottle, which seemed to have about the same amount that I have. But I couldn't commit myself definitely as to the amount of D. P. G. I had.

X260. Q. Well, you took that amount and dumped that on a piece of paper, and then sifted it onto the rubber?

A. No. I would have had there enough to have made more than one batch.

X261. Q. How many batches did you sift D. P. G. into?

A. Well, it would have meant sifting it into two or three batches.

X262. Q. Well, can you state just how many you did sift it into?

A. I would say at least two batches.

X263. Q. And how much compound was in each batch?

A. That would be about—well, there would be exactly 100 pounds.

X264. Q. And how much D. P. G. did you weigh into each batch?

A. Well, I haven't got that figure—the exact figure, but it would be a very small amount, a quarter or half an ounce per hundred pounds of rubber.

X265. Q. So you really divided the amount of D. P. G. into the two, and put that equally into two batches, is that what you did?

A. Yes, until my D. P. G. was all used up.

X266. Q. Well, did the amount you had just come out even?

A. I couldn't say as to that.

X267. Q. Do you now say that you may have had enough D. P. G. left over for part of a third or a succeeding batch?

A. Well, any amount of D. P. G. that would have been left over would not have been enough for a batch, or I would have used it in a batch. It would have been enough for some laboratory tests, but not tubes.

X268. Q. Well, take the succeeding batches, where you did not sift in the D. P G., did you put in the increased amount of magnesia yourself?

A. No. That formula was left right in the compound room after I made these substitutions of D. P. G. for the magnesia. I simply told the compound man, whoever he might have been—I don't remember as to that—to simply cut down the magnesia in these particular batches and I sifted the D. P. G. into those batches. When those batches were prepared, the card called T-8 was left in the factory until such time as it was changed again, which it was.

X269. Q. What is the reason you don't want to state what mannose R was?

A. Well, as I say, it is not customary for us to disclose the nature of any of the substances of that character that we are using in factory practice.

X270. Q. What about No. 40?

A. No. 40?

X271. Q. Yes.

A. What do you mean—what about it?

X272. Q. What was that?

A. What was it—it was gas black.

X273. Q. In this morning's testimony you referred to your table 1 in your paper, in your Norwalk experiments, as giving the same effect. Will you explain what you mean by "effect"—the different accelerators mentioned, you said, gave the same effect if used in varying quantities. Will you explain what you meant by the "same effect"?

A. I have forgotten with what I was comparing it. Was I comparing the publication with the Norwalk figures?

X274. Q. No, you used the same term in both. For example, in the National record, at page 37, you said: "That is, to determine how much of each one of these was required to give the same effect as three and one-half percent of anilin." This morning you used a similar expression. I am asking what you mean by "same effect".

A. By "same effect" I mean that in preparing slabs of rubber with anilin as the accelerator, it will give you a certain toughness or stiffness, or certain other properties, in that slab, that you can determine either roughly, by physical test with your thumb and tooth, or more accurately on a testing machine. The idea of that was to see how much of the other sub-

stances—D. P. G. and so on—would be required to give the same strength and elasticity—in other words, make the same type of compound with, as we call it, the accelerating effect. Now that term is a misnomer, inasmuch as certain accelerators like D. P. G. will toughen up your compound more than anilin, and really do not vulcanize the compound to the same effect as some other substances, but you estimate it as the same effect.

X275. Q. Then what you mean by "same effect" is nothing very tangible, is it?

A. I don't know how you could get anything more tangible.

X276. Q. Well, you can tell by thumb and tooth, and it may be the same or not, but it gives you the same impression?

A. Gives you the same physical strength.

X277. Q. I see I have omitted two questions about the tubes of the Falls Rubber Company which I would like to ask you now. One is: In the National record, at page 53, you said in speaking of diphenylguanidine, "I had a small quantity of it, and I put it in there and made it up into tubes," did you not?

A. Well, if you mean, did I make it—

X278. Q. No, I just asked you if you made that statement. I am going to give you a chance to explain. You did make that statement?

A. Oh, yes, sure, I made the statement.

X279. Q. I understand from what you have said today that all you really mean by "making that up into tubes" was that you sifted the D. P. G. as far as it went into batches on the rolls and then had nothing more to do with it. Is that right?

A. That is right, as far as that particular operation goes. Of course, I was supervisor of the mill work in connection with my other duties. If you mean, did I actually mix the batch,—no, I did not.

X280. Q. Well, now, what was the last time you saw the batch in which the D. P. G. went—immediately after it went in, or did you follow it further?

A. Well, the way we follow things—

X281. Q. I mean you personally.

A. I personally followed it farther than that, in accordance with the practice then in vogue, and which we still use, namely tagging that particular batch with a red tag, marking it, and having the calendar man who runs the tubes mark his rolls of stock made from that, and when the tubes are made up in the tube room the tag follows through, and the tube room man also tags his tubes, and then they were returned to my office. That procedure is still in use. I was only interested in a few of those tubes, to note their appearance and so on. The rest went into the regular stock—or rather into the regular completion of that order.

X282. Q. Did you say in your last answer that the D. P. G. batches were differently tagged than the other batches?

A. That would be right, yes, sir.

X283. Q. You personally saw that?

A. I couldn't say that I personally saw it. I personally gave instructions to that effect.

X284. Q. Well, how far from this point did you follow these two different mixtures that were sold later as tubes to Rubber City Clearing House?

A. Well, after the tubes were once mixed, and the D. P. G. in them, that is, in the stock, I was not particularly interested until the tagged tubes were returned to my office. I had no occasion to be interested.

X285. Q. Was there any different marking on one kind of tube than on the other—label or stencil or anything like that?

A. Absolutely not, except the ones that were sent back to me were accompanied by the red tag.

X286. Q. So that the one who got the tube would not know which was which, would he?

A. Absolutely not; unless the quality was such that he could tell by the feel of it.

X278. Q. Where you changed the batches, some having D. P. G. and some not, did not that necessitate a separation of these batches in calendering?

A. Yes, it should. The stocks were run out, but what we would call the tailings were mixed in with the aggregate of the other stock, that is, there was no effort made to keep the two stocks separate. That might have resulted in a greater acceleration of the other tubes, the regular T-8, than there otherwise should have been, because the D. P. G. would have gone through not 300 tubes, but through virtually a thousand tubes.

X288. Q. Yes, but should not the calendering man have commenced with the red tag to differentiate the D. P. G. batches from the regular T-8 batches?

A. No, because the batches were tagged when they went to the calender man. The mill man does the tagging.

X289. Q. The mill man does the tagging. You don't remember who that mill man was?

A. No, I wouldn't remember.

X290. Q. It might have been one of a half dozen persons there?

A. Well, we had five men—five men milling rubber at that time, and my recollection is we had five mills.

X291. Q. The figures as given by you in your Norwalk tests, and in table 1 of your paper generally agree, do they not?

A. They agree very, very closely—in fact, the tests in the paper were made just simply to confirm the Norwalk tests, and undoubtedly I was to a certain extent guided by my previous tests.

X292. Q. Well, I mean, in the paper as printed, you use one part of anilin, say, to .075 of D. P. G., and in the Norwalk test you use three and one-half of anilin to about .25 of D. P. G., do you not? So the ratio is—

A. Is virtually the same.

X293. Q. So isn't one just three and a half times the other?

A. The ratio of D. P. G. and anilin in the Norwalk work and the relation of D. P. G. and anilin in the work published is the same, virtually the same. That applies to all of them, with the possible exception of thiourea or urea, in which I have got some discrepancies in my results.

X294. Q. Is that your same opinion now, as it was then, as to these relative ratios?

A. It is on that method of testing, I would say, yes. I don't know as I would agree now, in view of

later work done the same way, that that would be the way to test them.

X295. Q. Well, you used two methods of testing. In Norwalk experiments you seemed to have had zinc present, whereas in the paper you did not, yet you seemed to get the same general ratios between these various substances, ranging from thio., including triphenylguanidine and diphenylguanidines. It that still your opinion?

A. Well, you are not considering one statement I have previously made, that certain substances, such as diphenylguanidine, toughen the stock in the way that misleads you. If I were repeating those experiments today, I would determine the actual amount of combined sulphur, and to my way of thinking, get it more accurately than I did at that time.

X296. Q. You mean, that the amount of combined sulphur is a better index of what you mean by "same effect" than any other tests that you know of?

A. Well, I am not up to date on the latest methods of testing rubber, but I think that the combined sulphur gives you a better estimate of the accelerating effect of the material. Now, I don't mean by that what I have previously spoken of as accelerating activity", which included physical properties and that sort of thing. I am speaking just strictly of the accelerator as an agent to promote the combination between rubber and sulphur.

X297. Q. Well, the term used for that today is sulphur co-efficient, is it not?

A. Yes. You mean, "sulphur co-efficient" as an expression of the combined sulphur and the rubber, its ratio?

X298. Q. Well, whatever it means.

A. Yes.

X299. Q. Is that the term in common use in preference to "combined sulphur", or do you go by "combined sulphur"?

A. No; "combined sulphur" would not mean much if your compound contains zinc, because you would figuring in the zinc, which was equal to the weight of your rubber, so you would only be getting —or you would be figuring your sulphur on a weight which is twice as much as it should be.

X300. Q. Well, suppose I take a lot of zinc gum stock, how do I tell what is a good stock—by sulphur co-efficient or combined sulphur or thumb and tooth test, or what?

A. You should consider all of them. And as I understand modern practice, they go in for a more elaborate method of testing, which they call stress-strain curves. I am not completely familiar with that method of testing.

X301. Q. In 1916 what equipment for testing physical qualities of rubber did the Norwalk company have?

A. We had—I couldn't say whether we had a Scott testing machine in 1916 or not. I believe we had though. That was the only machine that we would have for testing rubber, other than the thumb and tooth method, which I employed.

X302. Q. You made sulphur determinations at that time?

A. At Norwalk?

X303. Q. Yes.

A. We were not equipped to run elaborate sulphur determinations.

X304. Q. Well, did you make any?

A. Did we make any—on any stock, or on these particular stocks.

X305. Q. On accelerator stocks?

A. On accelerator stocks we certainly did, yes, sir.

X306. Q. And you formed your conclusions as to the value of accelerators by these sulphur determinations?

A. No, sir. If you will refer to one of the papers I published, you will find that in that paper I mentioned specifically that the sulphur co-efficient of an accelerated stock was not the correct indication of the proper cure as we understood it.

X307. Q. Is that your 1921 paper?

A. I wouldn't say as to that. It was in one of the papers though.

X308. Q. Well, later than the Exhibit E paper?

A. I couldn't say as to that.

X309. Q. I have here a paper in the "India Rubber World" of July, 1921, pages 744-745, and entitled "Action of certain organic accelerators in the vulcanization of rubber—III", by yourself and Mr. Flower and Mr. Shapiro. Is that the paper you mean?

A. I believe I had emphasized this statement considerably before this paper—I was going to say in a paper published in the "India Rubber Review" of 1916. That paper included accelerated stock, and I believe that statement was made there.

X310. Q. So that the opinions expressed in your

1916 and your 1921 papers are your opinions still, are they?

A. Well, I am not sure that that opinion was expressed in the 1916 paper. I am just quoting from memory there.

X311. Q. I mean, have you changed your opinion as expressed in the papers you have published?

A. Well, I am afraid I am a back number on publications now. I have been out of this work for over five years.

X312.Q. Well, at the time you published these several papers, did they correctly express your opinions at that time?

A. They certainly expressed our opinion, as we understood the subject which we were investigating.

X313. Q. Subsequent to the sale of tubes by Falls to Rubber City Clearing House, did the Falls Company, to your knowledge, use diphenylguanidine in any of its factory compounds?

A. Was your question how soon or did they?

X314. Q. (Question read.)

A. Yes. After these tubes—the Rubber City Clearing House tubes, after those tubes had been made, we used diphenylguanidine in the factory as soon as we could obtain it on a commercial scale.

X315. Q. When was that?

A. I couldn't say as to that.

X316. Q. From whom did you first obtain it, if you recall?

A. I don't remember that. Mr. Flower was in charge of the laboratory at that time.

By Mr. Wooster:

The paper from the India Rubber World, July, 1921, I would like to have marked for identification Plaintiff's Exhibit 11.

X317. Q. In your paper of April, 1920, where monophenylguanidine is mentioned, will you state how you determined the substance you used to be monophenylguanidine?

A. Well, I prepared it from a standard method, and determined the melting point of the purified product.

X318. Q. What is the method, and where do you find the reference to it?

A. Monophenylguanidine—that is shown on my Norwalk work there.

X319. Q. Is it printed in here (indicating record in National case)?

A. I believe that is shown on the Norwalk sheets there. If not, there is a statement on my own card. Those are the ones (Indicating cards): "Mono. No. 7, monophenylguanidine 25 percent. By heating monophenylthiourea with lead oxide in alcoholic lead ammonia."

X320. Q. This gives you a product after crystalization, melting at 173 C.?

A. Yes, as shown on this card.

X321. Q. How did you determine that to be monophenylguanidine?

A. Well, I had nothing to determine it as monophenylguanidine except method of preparation and the melting point, and, as I remember it, I ran into difficulty on this melting point and subsequently, in connection with that paper, I believe, I redetermined

it and found out it was 193. I don't know which is correct.

X322. Q. But in order to definitely identify this product as monophenylguanidine, would you have to determine the molecular weight or make determinations of carbon, hydrogen and nitrogen, on all of those?

A. For absolute identification?

X323. Q. Yes.

A. I think you would—at least make a more elaborate identification than I did, but we did not have the necessary apparatus at Norwalk to make either a molecular weight determination, or combustion to make determination of carbon, nitrogen and hydrogen, and so forth.

X324. Q. So what you think was monophenylguanidine, and so referred to in your paper and lecture, was not in fact that—is that possible?

A. Well, yes, that would be possible, to the same extent that, inasmuch as I did not make these determinations that you speak of, and which are very, very seldom made in this kind of work, the other substances would all be subject to the same interpretation. I never heard of anyone getting a piece of rubber, in a search of the character of ours, and going into the methods of identification you mention.

X325. Q. Can you give me a literature reference prior to September, 1919, stating that the melting point of monophenylguanidine is either 173 degrees C. or 193 degrees C.?

A. No, I certainly cannot offhand.

X326. Q. What you have mentioned as mono-

phenylguanidine, diphenylguanidine, and triphenylguanidine means in fact the free base of each of these substances, does it not,—rather than a chloride or other compound of the base?

A. Yes, that is right.

X327. Q. Were your experiments, as reported in your paper, made to show the relative utility of the substances tested, or to show the increase or variation in sulphur co-efficient?

A. Well, that would be a very difficult question to answer. Any paper of this kind that would be published, you could not dwell too much on the utility of the different substances, or your superiors would feel as though you were giving away company secrets.

X328. Q. And at the time you gave the lecture and at the time you published the paper, you did not feel authorized to give away company secrets, did you?

A. We felt authorized to disseminate information which we felt would be welcomed by other chemists, and that paper which was read in Philadelphia was the first open and above board discussion of accelerators that had been presented until that time.

X329. Q. You have not answered the question, which was: Did you feel authorized, either when you read the paper, or when you authorized its publication later, to give out company information regarding accelerators listed by you?

A. We absolutely had no intention of giving any information which any other company or competitor could transpose directly for practical purposes. Our idea, however, did give enough informa-

tion so that any reputable chemist would be guided by the information in the paper.

X330. Q. Guided to the extent of being put on inquiry, to find out for himself anything you did not say—is that right?

A. Guided to the extent of stimulating investigation along the same lines with which we were pioneering.

X331. Q. And without telling him what to investigate?

A. No, sir. We gave him two tables of what to investigate.

X332. Q. But I mean, you did not tell him any specific substance to investigate?

A. Well, we gave him two tables of substances, which we pointed out were excellent accelerators.

X333. Q. And he could take his choice from any one of the substances mentioned in the two tables?

A. Absolutely.

X334. Q. And go on invesigating for himself?

A. Yes, sir, because there is no one accelerator of universal application or universal quality.

X335. Q. And he had to find out for himself, from those you listed in the two tables, which, if any, would be of most nearly universal application. Is that right?

A. Well, I didn't know that anyone was seeking for a universal accelerator. We have never found that any one accelerator would suffice for all our purposes.

X336. Q. I asked you if a chemist or rubber man had been seeking for an accelerator which would be more universal than those he had, your table did not give him any light on it?

A. It certainly gave him a great deal of light, yes, sir, because it mentioned substances that the greater number of the gentlemen who heard my lecture did not know would accelerate the vulcanization of rubber.

X337. Q. And did your lecture still not leave to your hearers the necessity of listing all the different substances mentioned by you and then going on and investigating each of them for himself?

A. Not at all, no, sir, because as has been previously brought out in this case, anilin, thiocarbanilid, and so on, were already known.

X338. Q. Then as to those not at that time already known, did not your hearers have to investigate them for themselves?

A. Most assuredly yes. In fact, even granting we had told them exactly how to use each one of those, we would assume they would investigate for themselves.

X339. Q. Does your table indicate that anilin as an accelerator is of greater activity than diphenylthiourea or triphenylguanidine based on sulphur co-efficient?

A. No. As I remember that table, anilin is less active. It requires three and one-half percent of anilin, whereas, to get the same effect with diphenylthiourea, it only required three percent.

X340. Q. In table 1 you say one part of anilin exactly equals .85 of diphenylthiourea or .50 parts triphenylguanidine. Is not that the same relation as sulphur co-efficient?

A. Yes, I understand what you mean there. The relation is approximately the same—no, I can't

concede that, because certain of these substances, as we have known all along, mislead us by the fact that they toughen the rubber, while they may have a lower sulphur content than would be indicated by the stiffness of the slab. That has been known for a long time, and it has been the primary reason we have sought to investigate accelerators.

X341. Q. Did you make any sulphur determinations on stocks cured with monophenylguanidine and diphenylguanidine?

A. I can't say as to that offhand.

X342. Q. If you had, would you have given both monophenylguanidine and diphenylguanidine the same position as to activity relatively to anilin, in your table in your 1920 paper?

A. Inasmuch as I did not make the determinations, I couldn't answer that question.

X343. Q. Have you ever made sulphur determinations with mono and diphenylguanidine?

A. I couldn't say as to that.

X344. Q. Have you made a sulphur determination of triphenylguanidine?

A. I couldn't say as to that either. I believe that there are certain of those shown in some of those papers, triphenylguanidine particularly.

X345. Q. In table 4 of your 1920 paper you gave sulphur determinations of some accelerators, and in table 1 you gave other relations, and more particularly activity relatively to anilin. If you consider those tables separately, do you not get different ratios between these various accelerators than are mentioned in both tables?

A. I would certainly think you would.

X346. Q. That is, if you take table 4 and go by sulphur co-efficient, you get one result as to activity, and if you take table 1 and go by activity relatively to anilin, you get another result, as to results of those various accelerators.

A. Is that the way the results show?

X347. Q. Is not that so? Just compare tables 1 and 4 and state if they lead to the same conclusion as to relative activities of accelerators?

A. The results of these experiments as shown by tables 1 and 4 do not, strictly speaking, compare one to the other, and it is not to be expected that they would, as I have just emphasized—certain substances, like diphenylguanidine, toughen the rubber and lead you to believe that it is more vulcanized than it is. These results in table 4 show that, judged by sulphur co-efficient, anilin is slightly more powerful than thiocarbanilid, and that triphenylguanidine is more powerful than either of the others, and all of them are within the same degree—or all of them are accelerators of approximately the same degree; that is, none of them are equal to double the quantity of the other one. I mean by that, of those three there is no one that is twice as strong as either of the other two.

X348. Q. If one were following your table 1 of your paper, would he not take anilin as 1, diphenylthiourea as .85, and triphenylguanidine as .50?

A. That is right.

X349. Q. In order to get equal effect?

A. That is right.

X350. Q. If he were taking table 4, and drawing conclusions on combined sulphur co-efficient, that for anilin would be 3.625, that for diphenylthiourea

3.078, and that for triphenylguanidine 3.872, would it not?

A. That is right.

X351. Q. So that tables 1 and 4 do not check, do they?

A. No. I have emphasized that, that you cannot make them check, for the simple reason that you are mislead by the toughness that diphenylguanidine would impart to the vulcanized slab, making you believe that it was more vulcanized than it is. If you are making any such comparisons that we are trying to make here, it will lead into a highly technical discussion as to what constitutes the right cure of a rubber mixture and that is something on which there would be a variety of opinions.

By Mr. Wooster:

I object to all the answer after "No", as irresponsive and volunteered and move to strike it out.

By Mr. Edmonds:

That is not a proper objection. The witness must have a right to explain what his view on the thing is. Counsel cannot insist on having an answer no, which is subject to distortion.

By the Court:

He may answer no first, and then put in any explanation that he may desire—is the rule of cross-examination.

By Mr. Wooster:

Well, I am asking him what the effect is as appears from the face of his paper. Now, I think your Honor must agree that this paper

is offered for what appears on its face, and what it told people at the time it came out, and that this witness may not now come in and explain it by volunteered answers — explain what he really meant to show in that paper that he published in 1920, or what he should have said that he did not say. Now, I object here to his saying something now in answer to a question that simply requires a yes or no answer, that he should have said in the paper, if it was to have the effect that defendant here wants it to have. I think you must take that paper only for what it shows.

By the Court:

You are correct as to the consideration of it, but whether your examination is along the course of his knowledge, present and future,— I don't see that the answer must be stricken.

By Mr. Wooster:

But this question is a simple question as to his paper—the two tables in his paper.

By the Court:

Well, that may require some explanation as to that, which he may deem proper. That would be for subsequent consideration.

(Question and answer read.)

By the Court:

You are attempting to show some variation now, and I think he has undoubtedly a right to put his angle on it, to explain any particular differences that may appear. I refuse your motion and note you an exception.

X352. Q. In the experiments on which this paper of April, 1920, was based, did you notice any difference in the qualities of rubber slabs cured with triphenylguanidine and diphenylguanidine?

A. Yes, I certainly must or I would not have included them in the paper the way I did. As I remember, there was a large difference in the effect of each, between diphenylguanidine and triphenylguanidine—that is, there should have been quite a decided difference.

X353. Q. In what way?

A. One should be stiffer than the other, that is, the diphenyl. should be stiffer and tougher than the triphenyl. as examined over a range of cures. Please remember that these were not made on just tests of one slab; there was a series of slabs of each, to form the estimation. Sometimes you can judge the—or make comparisons better at an overcure or undercure than you can right at the right cure or critical point.

X354. Q. Well, take the mixture you gave, which was 92½ parts of rubber, 7.5 sulphur, cure .5 part of triphenylguanidine, in comparison with the same proportion of rubber and sulphur cured with .075 part of diphenylguanidine. Did you notice any difference in those two slabs, the cure in each case being the same?

A. In that case there, under the conditions of the experiment, those two slabs should have thumbed up about equally to the thumb and tooth.

X355. Q. How about tensible, aging, toughness, and set of these two pieces, were they all the same?

A. Well, if any experiments of that character

were made they were not recorded in this paper. I would have no way of answering that question.

X356. Q. Referring to defendant's Exhibit P, card No. 5, "Preparation of diphenylnaphthylguanidine," page 487 of National record, will you explain what is indicated by "LN VII"?

A. The LN refers to the compound number, wherein LN was used, three parts on a hundred of rubber, and accelerating that mixture. LN was our code name of lagosnaphthylamine, the lagos being sulphur carbanilid, which was simply heated with this naphthylamine, the idea being to see whether or not the heated mixture was greater in its accelerating activity than the sulphur carbanilid.

X357. Q. At this September meeting of 1919, of the American Chemical Society, Rubber Section, were there other papers on accelerators and rubber subjects that yours read?

A. Yes. That was a very large and well attended meeting. There were papers on a variety of subjects and I remember one very excellent paper on accelerators.

X358. Q. Did you hear one by D. F. Cranor?

A. Yes, I did.

X359. Q. Did you hear him mention an accelerator in which one-half percent would cure in five minutes at 40 pounds?

A. Yes, I did. In fact, I had previously discussed that with Mr. Cranor in his own company.

X360. Q. So that at the time you read this paper, neither D. P. G. nor M. P. G. were the strongest accelerators known to you, were they?

A. No, sir. I discovered a stronger accelerator myself in 1910.

X361. Q. And between 1910 and 1918 you heard of others that were stronger?

A. When you speak of "stronger" you mean—

X362. Q. More active, that will cure quicker?

A. More active, and cause the vulcanization to proceed more rapidly?

X363. Q. Yes.

A. Yes, we certainly had.

X364. Q. Quite a number of them?

A. Yes, sir.

X365. Q. And some of them were known in the literature prior to 1919?

A. Of the strong accelerators?

X366. Q. Of these strong or rapid accelerators?

A. There was a patent on an exceedingly active accelerator taken out in 1912 or 1913, I believe, a German patent.

X367. Q. Well, stronger ones today apply to what are known as ultra accelerators?

A. I had had little or no experience with ultra accelerators.

X368. Q. In your practical experience with the Diamond Company, the Norwalk Company and the Falls Company, was it the common practice of any of these companies to put the accelerator into a factory compound and sell that product in regular trade, without subjecting it to practical tests?

A. It certainly was not, no, sir.

X369. Q. That is, you would not put an accelerator into your commercial product on what you found out from a thumb and tooth test, would you?

A. Before I went to Falls Rubber Company,

that was virtually the way they were testing all of their substances.

X370. Q. I mean, that was not regarded as a safe thing to do, was it?

A. Not regarded as safe, and yet there are thousands and thousands of tires being made today with no other tests being made upon them than that.

X371. Q. Now, take this tube formula that was sold to the Rubber City Clearing House, to your knowledge had that formulae ever been put in a test car and actually run, to see how that tube would stand up?

A. I believe it had, but I would not commit myself definitely there.

X372. Q. That is the T-8 formula?

A. Yes.

X373. Q. T-8 formula had been run in test cars?

A. No,—I say I would not commit myself definitely. This 63 or T-8, or whatever you call it, is a formula that has been used by other companies besides ourselves. It is essentially, in its main constitutent, that which has been used by at least two companies, to my knowledge, in the manufacture of inner tubes.

X374. Q. So that did not need any road test, is that your idea?

A. It did not need as much of a test in that way as if it had been an entirely strange or new mixture to me.

X375. Q. So you took this, what you say was a more or less standard formula, and took out the mannose R, and put something else in, with reduc-

tion of magnesia, and sold it right out on the market, without ever testing that tube in a test car, did you not?

A. Yes. Those particular tubes containing the D. P. G., I have no record of them being actually tested on a test car.

X376. Q. You did not tell the customer what you were doing, did you—at least not that part of his order?

A. No, because I knew I was giving several hundred—or two or thre hundred tubes at least of better quality than he expected. There was no necessity for telling him.

X377. Q. How can you say that, when you say that you did not distinguish the two tubes when they got through your plant?

A. Well, there was a certain number of them had D. P. G. in them, and those tubes were better tubes than the ones that did not have any D. P. G. in them.

X378. Q. But you said they could not be told apart?

A. There was no necessity of telling them apart.

X379. Q. Well, what is your basis for saying that the D. P. G. tubes were better than the T-8 tubes?

A. Well, you can tell in almost the feel of them.

X380. Q. You mean you could tell?

A. Yes.

X381. Q. But you let them go out without telling that, didn't you?

A. Certainly. There was no occasion to tell the customer about it.

X382. Q. Isn't it a fact that you simply assumed that the D. P. G. tubes were better?

A. No. I thought that they felt better and tougher. I had tests made of the stock, but I couldn't state definitely that it was made of the stock with the D. P. G. in it.

X383. Q. Referring to this exhibit U, "Physical Test Sheet"—was any of that record made by you?

A. No, sir. That was made by my assistant in the laboratory.

REDIRECT EXAMINATION.

By Mr. Edmonds:

384. Q. Doctor, you said that there was no accelerator of general application. Is that true today?

A. You mean, no one accelerator that fits all purposes equally well?

385. Q. Yes.

A. There certainly is not, to my knowledge.

386. Q. Will you name some of the conditions or factors that are considered in selecting the proper accelerator to meet a specified situation?

A. Well, my experience is mostly with tire stocks, and for our particular purposes we want an accelerator that is reasonably fast, such as D. P. G., but not as fast as the ultra accelerators. We desire to have it white, powder, non-toxic, and possibly water soluble. There would be a number of specifications on which we would all differ as to exactly what would be the ideal accelerator, but I don't know of any that meet them.

387. Q. In your work with your company, as well as in the work of other companies, the available information about accelerators is in a state of continual development, is it not?

A. It certainly is, yes.

388. Q. Then the difference between what is known now and what was known in 1921 or 1922 is very considerable?

A. Tremendous advances have been made since 1920.

389. Q. You were asked about when, after making these tubes in 1917, you or your Falls Company made use of D. P. G. in commercial operations. I wish you would state whether or not at any point in that period of time you developed any plans for the manufacture of D. P. G. by the Falls Company, and what was done in that connection?

By Mr. Wooster:

I object to that as outside the cross-examination.

Objection overruled.

Exception noted to plaintiff.

390. Q. Will you state briefly what was done in the way of plans for the use of or manufacture of D. P. G. by the Falls Company, or any accelerator?

By the Court:

Now, I don't see why you need go into detail on that, to show what he has done. It seems to me it is more or less collateral, affecting possibly his general credibility, and the weight to be given his testimony. Otherwise, I cannot see what effect it has.

By Mr. Edmonds:

I think it is without effect, unless these gentlemen think there is some special point to be made out of the lapse of time that occurred between the making of these tubes in 1917 and the publication of the paper in 1919, during which period this witness made some tests of the D. P. G., as he has already explained, and which bridges over that period of time—

By the Court:

Perhaps we are taking up longer time than it would take to bring out the testimony. Proceed.

391. Q. Will you state that?

A. The subject of accelerators at that time was difficult, in as much as you could not obtain on the open market certain desirable accelerators, not only D. P. G. but others as well. In March, 1919, I wrote our President, Mr. O'Donnell, a letter wherein I requested an appropriation to build a chemical plant for the manufacture of accelerators. I repeated this request in another letter of September, 1919, wherein I even had the plans of the building drawn up. Unfortunately the boom came to an end at that time and funds were not available to go ahead with this program.

392. Q. Can you state the exact date when you read this paper of yours at the Philadelphia meeting?

A. The meeting itself was between September 2-6, 1919, and as I remember it, my paper was read on a Thursday between those two dates.

393. Q. Now, by way of introducing the next witness, will you state whether or not you have recently,

at my request, had some rubber made up in accordance with this formulae for the 1917 tubes, with and without D. P. G.?

A. I have, yes, sir.

394. Q. And who did you have do that?

A. I requested Mr. J. F. McWhorter to make up tubes in accordance with the same procedure as used in 1917, using both D. P. G. and magnesia in the amounts I used then, and also omitting the D. P. G. and just using the magnesia, or T-8.

JOHN FRANCIS McWHORTER, a witness produced in behalf of the defendant, being duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. You reside in Cuyahoga Falls or near there?

A. I do, yes, sir.

2. Q. And you are in the employ of the Falls Rubber Company?

A. I am.

3. Q. In what capacity?

A. As a chemist.

4. Q. Are you a graduate chemist?

A. I am.

5. Q. From what college?

A. University of Delaware, Newark, Delaware.

6. Q. How long have you been working directly in the chemistry of rubber?

A. My first work in the chemistry of rubbber was with the Firestone Fellowship, in the Fall of 1922. I

came with the Firestone Fellowship and studied at the University of Akron for one year.

7. Q. And what did you do after that?—

A. Not quite a year—at the end of the college year. Then I went with the Firestone Company in June, that following June, and worked there as an analytical chemist until February of the following year, that was February of 1924.

8. Q. And then?

A. And from there I went into sales work. I was in sales work for about a year and then I came back, and I was in rubber hose compounding with the Goodrich for about five or six months, and then I went with the Falls Rubber.

9. Q. Have you recently made up some rubber samples, at the request of Dr. Kratz?

A. I have.

10. Q. Will you produce them?

By Mr. Kennedy:

Objected to on this ground: obviously this test was one made for the purposes of the case. Nobody for plaintiff was present or invited to be present at this test. Under the authorities such tests have but little, if any, weight with the Courts. I doubt, if there is an objection they would go so far as to call for the exclusion of the testimony, but it is an effective objection so far as the weight of the testimony is concerned, and I think should be stated at the present time, before the testimony is adduced.

By the Court:

It only goes to the weight. We will overrule the objection and note you an exception.

By Mr. Kennedy:

We have no opportunity, of course, to reply to testimony like this, which we hear for the first time now.

11. Q. Will you produce these things?

A. The tubes?

12. Q. Yes.

A. (Witness produces tubes.)

By Mr. Kennedy:

May I have a running objection so as to save time, your Honor?

By the Court:

Yes. Same ruling and same exception.

A. The tube labeled A is the diphenylguanidine. The tube labeled B is without.

13. Q. These were made by you recently?

A. Yes, sir.

14. Q. At the Cuyahoga Falls Rubber Company?

A. Yes, sir.

15. Q. How does the formula for them differ, otherwise,—first, the one which has D. P. G. in it, and the other which has not—how do the formulas differ, other than that one has D. P. G. and the other has not?

A. The formulas are identical with the exception that the tube A has .2 parts D. P. G. added.

16. Q. And the other has not?

A. The other has not, B has not.

17. Q. Now, have you got here the formula that you used in making the mix for these two tubes?

A. Yes, sir.

By Mr. Edmonds:

I offer these two tubes in evidence, the tube marked A to become defendant's Exhibit V, and the tube marked B, to become defendant's Exhibit W.

18. Q. Now, what is this card that you have just handed me? What is that the formula for?

A. That is the formula for the B tube.

19. Q. And this second card?

A. That is the formula for A tube.

20. Q. And that is the formulae on which you made these two tubes?

A. Yes, sir.

By Mr. Edmonds:

I offer these two cards in evidence. They may go in as one exhibit, defendant's Exhibit X, as the difference between them is quite apparent.

By the Court:

We will admit them subject to the objection of counsel, and the same ruling and exception.

21. Q. Now, have you performed any test of the rubber going into these two tubes, that will give comparative values for certain factors in the rubber?

A. Yes, sir.

22. Q. Will you state with what result?

A. No. A, with D. P. G., records a tensile of 1858 and elongation of 688 lengthwise; crosswise, 1845 tensile, elongation 725; which gives an average tensile of 1852 and average elongation of 707. No. B, without D. P. G., gives tensile lengthwise of 1428, and elongation of 685; crosswise, tensile 1426, elonga-

tion 720, which gives an average tensile of 1427, elongation 703.

23. Q. Now, I think there is one little matter that has to be cleared up,—this proportion of D. P. G. as given on one of these cards Exhibit X appears to be .2 parts in the whole compound. Is that correct?

A. Yes.

24. Q. And the percentage of the D. P. G. to the rubber in the compound would have to be calculated with reference to the amount of rubber in these first three items?

A. Yes. That is, .2 part on 558.2 grams.

CROSS-EXAMINATION.

By Mr. Wooster:

Cross-examination without waiver of objections.

By Mr. Wooster:

X25. Q. These tests were made yesterday—October 12, 1925?

A. Yes, sir.

X26. Q. On request of whom?

A. On request of Mr. Kratz.

X27. Q. And the formula—where did you get the formulas?

A. I have the sheet here, producing photographic sheet of Exhibit E, with the exception of this part here (ind.), that is crossed out.

X28. Q. Is the quality and nature of smoked sheet rubber, to your knowledge, the same today as it was in 1917?

A. Not having used smoked sheet rubber in 1917 I am not prepared to say.

X29. Q. You don't know. The same question as to latex?

A. The same answer as to latex.

X30. Q. What is "HG Reclaim"?

A. HG Reclaim is a bundle of reclaim that I got in the shipping room of the Falls Rubber Company, with "HG" marked on it.

X31. Q. I notice on your card produced, Exhibit X, you say, "HG Reclaim", whereas on the photographic copy given you by Mr. Kratz there appears only "HG". Who told you that "HG" means the same as "HG Reclaim"?

A. Well, I have some cards to that effect, that Mr. Kratz called me over the phone and read them out over the phone, before he gave me this, with all that on it written out.

X32. Q. When did he do that?

A. That was one day last week, I can't say just what day. He called me over the phone and dictated these two compounds.

X33. Q. And you wrote them down from what he said over the phone?

A. I wrote them down over the phone, yes, and then to check absolutely, I was given that.

X34. Q. How many different kinds of "Brown Substitute", as you write it, or "Brown Sub." as written by Dr. Kratz, are there, do you know?

A. I know of only one Brown Substitute, and that is, "Brown Substitute." That is all I have ever heard of.

X35. Q. How many different brands of that material do you know of?

A. Only one, and that is, "Brown Substitute."

X36. Q. When did you first hear of that one?

A. I just heard the name, "Brown Substitute" several times.

X37. Q. Last week, is that the first you knew of it?

A. Well, I have heard of the substance, "Brown Substitute."

X38. Q. Is that the first time you have ever used it?

A. That is the first time I ever used it in a compound, yes.

X39. Q. Where did you get the "Brown Sub" which you used in making up these two Exhibit tubes?

A. The purchasing agent of the Falls Rubber plant sent out and got it.

X40. Q. Did he say that was the same that was used in 1917?

A. He gave me no information on it.

X41. Q. You don't know anything about how Brown Sub. that you buy today compares with that to be had in 1917, do you?

A. No, sir.

X42. Q. What was the brand name of this Brown sub. which you used?

A. Just Brown Substitute, that is what we order. That is what we order, Brown Substitute, and that is what is sent.

X43. Q. Who from?

A. I sent my—

X44. Q. I mean, where did you buy it? What concern did you buy it from?

A. I don't know. The purchasing agent buys it?

X45. Q. You don't know whose Brown Sub this it? Do you know the nature of Brown Sub.?

A. Do I know what it is?

X46. Q. Yes.

A. Yes, a burned oil.

X47. Q. What else in it?

A. I don't know.

X48. Q. What kind of oil?

A. I don't know.

X49. Q. Any rubber in it?

A. I don't know.

X50. Q. Any reclaimed rubber in it?

A. I don't know.

X51. Q. Any sulphur in it?

A. It has to be vulcanized.

X52. Q. I say, is there any sulphur in Brown Sub?

A. I don't know.

X53. Q. And this is the first you ever heard of it, when you were asked to get some from your stock room or purchasing agent, and make these tubes?

A. This is the first I ever used it.

X59. Q. Did you say the stock man went out and bought some, or gave you some that was already on hand?

A. We ordered it from him and he got some.

X55. Q. He didn't have any on hand?

A. He had none on hand at the time in the factory.

X56. Q. What do you understand by "mineral rubber?"

A. "Mineral rubber" is sort of a dark flaxy substance, that we put in the rubber compound.

X57. Q. Any sulphur in it?

A. I don't know.

X58. Q. What is "Blank Fix"?

A. Blank fix is a white pigment.

X59. Q. The other things mentioned here, of zinc oxide, sulphur, carbon black, parafine, magnesium oxide, are well known compounding ingredients, are they not?

A. As far as I know.

X60. Q. Where did you get the cures for these tubes?

A. From Mr. Kratz.

X61. Q. What were they?

A. Five minute rise, 35 and 40 pounds.

X62. Q. What does that mean?

A. It means you take five minutes to let your pressure go up to 40 pounds, and then you let your pressure stay at 40 pounds for 35 minutes and take your tubes out.

X63. Q. Open cure?

A. It is cured in a glass receptacle that they cure the tubes in.

X64. Q. I mean, were these tubes?

A. Cured in the regular way the factory cure.

X65. Q. How were these tubes cured?

A. In the same way that factory tubes are cured.

X66. Q. What you call open steam cure?

A. Open steam, on a mandrel. They were cured on a mandrel, and wrapped—wrapped with cloth and cured on a mandrel, in the presence of steam.

X67. Q. And then unwrapped and reversed and spliced?

A. And spliced.

X68. Q. Who did the work?

A. What do you mean—what work?

X69. Q. Of compounding.

A. Of putting up the material—the chief mill man and myself.

X70. Q. Who broke down the rubber?

A. The chief mill man and myself.

X71. Q. Who did the milling?

A. The chief mill man and myself.

X72. Q. Who did the weighing?

A. The chief mill man and myself.

X73. Q. Who did the calendering?

A. The chief mill man and myself, with three or four others around.

X74. Q. It took two of you to weigh out the accelerator?

A. I weighed the accelerator myself.

X75. Q. Where did you get that accelerator?

A. It was a sample of D. P. G. from the American Cyanimid Company—a tin box.

X76. Q. Oh, not made by Mr. Kratz?

A. No, sir.

X77. Q. What is known as commercially pure D. P. G.?

A. I know nothing further than the fact that we used it in the laboratory.

X78. Q. That is a standard brand of D. P. G. on the market today?

A. Nobody markets it but the American Cyanimid Company.

X79. Q. That is a standard brand on the market today?

A. So far as I know.

X80. Q. This is the first time you ever used it?

A. The first time I ever used it in tubes.

X81. Q. The first time you ever compounded D. P. G.?

A. Only in experimental work.

X82. Q. How many brands are there on the market today?

A. I can't distinguish between that.

X83. Q. You know only one, this American Cyanimid brand?

A. That happened to be the one I used.

X84. Q. Who told you to get it from the American Cyanimid Company?

A. We had it in the laboratory.

X85. Q. What is this mannose R which is mentioned on this photograph which you produced?

By Mr. Edmonds:

Just a minute. I think you ought to respect Dr. Kratz's disinclination to make that public. He has told you that is an accelerator and he has told you a perfectly legitimate reason why he does not want to have it stated what that is, and I think that ought to be respected.

By Mr. Wooster:

We have here a witness who knows what it was, and is going to say so, and there is no more reason now for Dr. Kratz and Mr. Edmonds not telling what Mannose R was, or is, than there was in the National suit, where the in-

quiry was made, and it was not pressed, and we determined to press it here as far as the Court will receive the evidence. We think it is just as likely that the tubes that were sold to the Rubber City Clearing House in 1918 were made with this Mannose R as they were with thio. or D. P. G., or magnesia, or anything else. We think it quite important in this case that that be stated. And moreover, the Falls Rubber Company has not been subpoenaed here. Its Vice President comes here voluntarily, and he brings the company's records with him, presumably with permission of his company, if he needed any, and we don't think he should come here and make a secret of something that is not really a secret.

By Mr. Edmonds:

Aside from my previous objection, this question is irrelevant as put to this witness. This witness has not used any mannose R. The substance that he used are on these two cards, Exhibit "X," and what is on these cards is all that he has been questioned about.

By Mr. Wooster:

Oh, no.

By Mr. Edmonds:

Counsel goes outside the direct examination.

By the Court:

There is not much question about it, if that is the only one.

By Mr. Edmonds:

No, sir, there is no mannose R in there, in those two tubes, which is the only thing this witness has been questioned about.

By the Court:

Well, that would make it very plain. If he did not deal with it, then it would be entirely outside the cross-examination. I will sustain the objection, put in that form, because I do not think it throws any light on the present inquiry before us, and it would be just a mere disclosure of a secret which may be of value or no value, I don't know.

Adjourned until Wednesday, October 14, 1925, at ten o'clock A. M.

Wednesday, October 14, 1925.

MORNING SESSION.

JOHN FRANCIS McWHORTER resumes the stand.

By Mr. Wooster:

The tube offered as Exhibit "W," made according to formula 63-W, the card forming part of Exhibit "X," is further objected to as immaterial and irrelevant to the issue in this case, because not made in accordance with the testimony that Mr. Kratz gave yesterday, wherein he said that three parts of magnesia were used in the tubes which did not have D. P. G., and this exhibit card of compound 63-W shows one

part. This exhibit, therefore, is no standard of comparison with what Mr. Kratz says he made.

CROSS-EXAMINATION (Continued)

By Mr. Wooster:

X86. Q. How many plies are these exhibit tubes?

By the Court:

As the statement was, I don't think that affects the admissibility of the matter in evidence to show what he has done.

By Mr. Edmonds:

I do not offer these tubes on the theory that both of them are products of what Kratz did. We offer them on the theory that the difference between them will be enlightening as to the effect that certain substances have.

By the Court:

An exception is noted to the plaintiff.

By Mr. Wooster:

X87. Q. How many plies are these tubes made from?

A. Two plies.

X88. Q. Where did you get that instruction?

A. It is the regular way of making up factory tubes.

X89. Q. Mr. Kratz didn't tell you to do it that way?

A. He just told me to make them up in the regular factory manner.

X90. Q. You used two plies on your own responsibility?

A. I used two plies because he told me to make them in the regular factory manner.

X91. Q. Do you not at times make three and four ply tubes?

A. Not to my knowledge.

X92. Q. Have you the weight of these tubes?

A. I have not.

By Mr. Edmonds:

Mr. Wooster says he wants on the record the weight of these two tubes without the valve stems. Will you please take the tubes with you to some place in this building, where I understand there are scales, and weigh them, and come back here and report what the weights are. That I understand concludes this testimony.

SETH R. CLARK, a witness called on behalf of defendants and duly sworn.

By Mr. Edmonds:

As I stated a day or two ago, we entered into a stipulation that the testimony of certain witnesses in the National suit might be received here as though taken here. Among others, was the testimony of this Mr. Clark. At the time I asked Mr. Wooster to include Mr. Clark in that stipulation, as I had no idea of bringing him here to the trial; but since then we have found it was possible to do so. So if Mr. Wooster cares to withdraw from the stipulation, so far as concerns the testimony of Mr. Clark, I think he should be permitted to do so, and we will take Mr. Clark's tes-

timony all over again. On the other hand, if he will allow the testimony to stand as it is, we will simply go on with additional matter.

By Mr. Wooster:

I would prefer that the stipulation stand, and that the deposition of Mr. Clark as given in the other case be taken for what it is worth, as far as it goes, and let Mr. Edmonds proceed.

By Mr. Edmonds:

That is what I prefer.

By the Court:

Very well.

By Mr. Edmonds:

1. Q. You were in the employ of the Republic Company around in 1915, '16, '17 and '18?

A. I was.

2. Q. And you knew Mr. Brill, who was employed by the Republic?

A. I did.

3. Q. What was your capacity with the Republic Company?

A. During those years, I was assistant mill superintendent in charge of development work.

4. Q. And Brill's position was what?

A. Brill's position when he first came there was chemist in the laboratory, and he was later appointed chief chemist.

5. Q. What accelerators were you using in 1916 and the early part of 1917?

A. We were using thiocarbanilid back in some years. I am not sure just when we started. We also

used in a small way paranitrosodimethylanalin and hexa.

6. Q. Were those accelerators that you were using considered by you and other officials of the company to be satisfactory?

A. Not wholly. Please understand that our production there, in those years especially, was probably more along the line of mechanical goods than it was in tires, and we were especially working for an accelerator which would work especially well with our mechanical goods. None of these filled the bill.

7. Q. If they were not entirely satisfactory, what did you do to try to improve conditions?

A. We were continually on the search for accelerators. Moreover, if we heard of a chemist whom we thought had some experience in accelerators, we would try to pick him up. In our search for accelerators, on account of all information on accelerators being held more or less secret at the time, it was a question of trying things out hit-or-miss, and seeing whether they would work or not. Of course, we had certain ideas as to what classes of organic materials would fit in with what we wanted to try to find.

8. Q. Are you a chemist?

A. I am a chemist.

9. Q. Did you confer with Brill in connection with this matter of finding a better accelerator?

A. I did confer with Brill and others in the organization.

10. Q. Once or many times?

A. Many times.

11. Q. What was the result of your consultations with Brill, what conclusion did you reach?

A. The time of the different chemists there in the laboratory was pretty well taken up with outside matters, following troubles throughout the plant. We finally came to the conclusion that the only way we could make what progress we wanted to on accelerators was to put a special man on that work. That I know was during Brill's time.

12. Q. What was the nature of the progress that you wanted to make on this work?

A. We wanted to put a man on it who would devote all his time to investigating right down, wherever we could find them, organic materials.

13. Q. Then you proposed to have some trained chemist investigate a series of substances?

A. Absolutely.

14. Q. What series of substances?

A. Well, the first thing they would have to be organic materials that would melt within the range of our rubber. We had decided by that time they must be organic materials that we would reach in nitrogen and basic.

15. Q. Did you get a chemist to do that?

A. We did.

16. Q. Who was that?

A. Mr. Baldwin.

17. Q. Did you put him to work on this job you said you wanted to work on?

A. We did.

18. Q. What did he do in that job?

A. He was supposed to do largely as I outlined, and he did it. I would like to say that I never posed as an organic chemist. I therefore put it up to Brill to get together with Baldwin and go right down

through whatever literature he had, and search out and try out anything that looked good, and not only myself but Mr. Peterson would O. K. the purchase of anything we could get that looked anything favorable at all.

19. Q. Do you know whether a selection of substances for this trial in this manner was made?

A. I do.

20. Q. What was done about obtaining these substances?

A. We just simply made out a list of accelerators and gave it to our purchasing agent to purchase. I probably wouldn't recall very much about that, except that on account of the fact that this was along during the period of the war, numbers of these accelerators were very very hard to obtain, and I know that on several occasions the purchasing agent, when he would be with me, would tell me—would sort of throw up his hands and say, "Well, I can't get some of those materials, and some are going to cost you an awful lot of money." I would be safe in saying that I know some of those were quoted to us at prices of four or five dollars an ounce.

21. Q. Are you able to state now, from your recollection, the names of definite substances that were tried in the course of that work?

A. I cannot.

22. Q. You have no recollection of the specific test made with D. P. G.?

A. No, sir.

23. Q. This X-book of course you recognize as one of the laboratory books of the Republic Rubber Company?

A. I do.

24. Q. The use of this book as a place to record experiments was well known to you?

A. Yes. I installed that system.

25. Q. The book referred to is the 2000 X-book. Did you give any instructions as to what was to be recorded in this book?

A. It was an infallible rule that every experiment was to be recorded in the X-book at the time it was mixed.

26. Q. I call your attention to the entry on page X-2005, in the first column of figures, where it indicates that the test was one of a compound including one part of diphenylguanidine. What have you to say about that?

A. I dont recall any such test having been made, but I am not at all surprised that it is there.

27. Q. Would such a test be in line with the work you said Baldwin was hired to do, and did do?

A. It absolutely would be.

28. Q. Now, turning to a later time, do you recall that Weiss was employed there in the laboratory, and you were familiar with his employment?

A. Yes, sir.

29. Q. Were you familiar with the character of his work?

A. I was familiar with it.

30. Q. Was that work satisfactory?

A. It was not wholly satisfactory.

31. Q. Did the unsatisfactory character of work come to your attention?

A. It came to my attention in such a way that

several men in the organization, not wholly in the laboratory, men outside of the laboratory in the organization, commented to me regarding Mr. Weiss's continued employment in the laboratory.

32. Q. What did you decide to do about it?

A. We decided that as time went on, we would try to select men whom we thought more fitted for the position.

33. Q. Did you discuss that with Daniels?

A. I remember very distinctly discussing it with Daniels at various times.

34. Q. Did Daniels indicate any difference of opinion as to Weiss's ability and value to the company? Did he indicate that he held a different opinion from the one you have just expressed?

A. Not any very fixed opinion; no, sir.

35. Q. Did he ever state to you that Weiss had developed something that would have been of value and would justify keeping him?

A. Never.

36. Q. Did he ever state that at any time through the year 1919?

A. No, sir. During the latter part of 1919, Mr. Weiss's progress on making D. P. G. was so small that it was quite the reverse.

37. Q. At any time up to September, 1919, did Daniels ever say to you that Weiss was developing something that would probably be of considerable value to the Republic Rubber Company, and that you had better keep him for that reason?

A. Not to create any impression on my mind.

38. Q. Nothing of that sort occurred?

A. No, sir.

39. Q. What about Stevens, another employee there? You sent him to New York along in the fall of 1919. What was the purpose involved in that?

A. Mr. Stevens went to New York to investigate, in the first place, mechanical belts. I believe on his first trip he investigated little else, but on his second trip we combined the investigation of belts with the investigation of accelerators in general, largely at first to better our method of making T. P. G., which during 1919 I would say we considered our main accelerator, aside from thiocarbanilid. We had almost passed up paranitroso and used very little hexa., because hexa. caused poisoning in the plant. So the last trip that Stevens took was both on belts and accelerators.

CROSS-EXAMINATION.

By Mr. Wooster:

X40 Q. When did this discussion, to your recollection, first come up, regarding the unsatisfactory work of Mr. Weiss?

A. I couldn't give you any exact date.

X41. Q. What year?

A. I can fix one date. One date was during the regime of Mr. Norwood, which was during 1918 and '19. I know certain men in Mr. Norwood's organization spoke to me regarding the unsatisfactoriness of Mr. Weiss in the laboratory.

X42. Q. Would you say it was in 1918 that this objection to Mr. Weiss was first voiced?

A. I doubt very much if I heard very much about it until in 1919.

X43. Q. What part of 1919?

A. Probably fairly early in 1919.

X44. Q. February of 1919?

A. I wouldn't put any exact date on it.

A. I don't know.

X45. Q. When did Mr. Weiss leave?

A. Mr. Weiss left the employment of the company in March, 1920.

X46. Q. Was it within your authority to discharge him?

A. It was.

X47. Q. You didn't do it?

A. No, sir.

RE-DIRECT EXAMINATION.

By Mr. Edmonds:

48. Q. You didn't discharge Weiss?

A. I discharged him in March, 1920.

49. Q. It was not within your province to do it before that?

A. It was.

50. Q. In March, 1920, you had specific directions to do it?

A. I had specific directions to let him go.

51. Q. And would you say the same of Mr. Daniels?

A. Yes.

By Mr. Wooster:

52. Q. Wasn't Mr. Weiss's salary raised during the year 1919?

A. I wouldn't say as to that. It may or may not have been.

JOHN VREELAND HARING, a witness called on behalf of defendants, having been duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Edmonds:

1. Q. Where is your residence?

A. 114 Park Avenue, Newark, New Jersey.

2. Q. And your occupation?

A. Examiner of questioned documents.

3. Q. How long have you followed that occupation?

A. For over thirty-five years I have been engaged in penmanship work, designing alphabets for educational purposes to be used for copy-books, plain and ornamental penmanships, making facsimile signatures, and for over twenty years I have been called upon to pass an opinion regarding questioned handwriting.

4. Q. Have you frequently had occasion to testify on such matters?

A. I have testified in New York, New Jersey, Pennsylvania, Maine, West Virginia, and other states.

5. Q. I call your attention to the 2,000 X-book, page X-2034, and particularly to the date at the bottom of the column "E". It has been stated in this record that the figure indicating the month of the date at the bottom of that column has been changed, and that after being changed it was supposed to represent a "2". Will you state what figure, in your opinion, was there before the change was made?

A. I will.

6. Q. Please do.

A. Figure 9.

7. Q. Will you state your reasons for asserting that the figure there initially was the figure "9"?

A. The manner in which the oval is attached to the staff. Also, in comparing it with the figure "9" in the same entry, and the way in which it was built up into a figure "2".

8. Q. Will you explain more fully what you mean by the way in which the initial figure was built up into a "2"?

A. By the addition of a little stroke in a horizontal manner at the base of the oval, and the addition also of a little tick or stroke in the right side of the oval half way up; by the addition of the horizontal base line at the base of the staff.

9. Q. Can you give any reasons why the original figure was not a "1"?

A. Yes. The manner in which the loop is formed, or the oval, would be inconsistent with the making of a "2" out of the figure "1". The person who changed it would first have to make a "9" and then change it into a "2" by adding the horizontal line at the base of the staff. The entrance also of the base of the oval that was untouched by the second operation, into the staff or down-stroke of the main part of that figure, shows that it was a part of the figure "9".

10. Q. Can you elucidate further your statement that the figure there initially was a "9", by reference to any photograph studies of this date?

A. I can. I ought to state also that I have examined this previous to this occasion. I have also examined it with the aid of a microscope under daylight, and with magnifying glasses of varying strength.

11. Q. Will you proceed with your reference to photographs?

A. I had the page photographed at the office of the Lee Tire & Rubber Company of New York City some three weeks ago. I then had prints of that negative made, and I also made prints myself from the negative. I enlarged those prints to this present enlargement.

12. Q. State what that shows?

A. That shows the figure "2" segregated from the balance of the entry, in enlarged form, about seven times as large, showing in prominent form what is observable by the microscope.

13. Q. What did you discover on the study of this enlargement?

A. That in converting the figure "9" into a "2", the pen had been lifted in an unusual way. In some instances, for instance, in making the staff of the figure, the penholder was held directly pointing toward the body of the writer, turned in this manner toward my person. In making the additional stroke at the base of the oval, the pen was held in a different direction. It was held off to the right of the writer, away to the writer's shoulder, making the nibs spread in that horiontal direction. The base of the staff in attaching the bottom stroke of the figure 2 as it stands was also made with the pen held well over to the right of the writer. The formation of the oval, as originally made, is shown by an unattached portion which shows the collar on this photograph, to enter into the staff in the same manner as the accompanying entry 9 enters the staff at that point of the

oval. The little tick was aided in the center of the oval, to the right side, entering the staff, with the pen held in the position similar to that when the bottom of the staff was made at the time of the "2". This tick would indicate that the pen started at that point in forming the oval, but the indication of the line contradicts it. The indication of the balance of the oval contradicts that it started at that point. The pen was held off to the right in that manner in making this start, making an increased pressure and deposit of ink as it entered into a down-stroke. Now, if the pen were continued, started there and came down, made a turn at the bottom, and then up at the top, there would be an increased pressure at the top right corner equal to the tick, or even greater than the tick where it entered into the main down-stroke of the figure.

14. Q. But no such increased pressure is there?

A. No. On the other hand, the line indicates that it was made with an upward stroke and then entered into the oval with a little deposit of ink, not a spreading of the nibs.

15. Q. The line you refer to is the loop of the "9"?

A. The top lefthand loop of the "9", similar to the shade appearing on the "9" in the same entry. Then it comes down along the left side of that oval, and at the base of the oval appear to pen nibs, impressions, where the line was drawn and entered the staff. Now, immediately above those pen nib impressions is a little color showing where the original pen stroke, unshaded, unrecorded with nibs, similar to the "9" accompanying, entered into the staff.

16. Q. At that point the original "9" was retouched?

A. Yes; and the staff made with a spreading of the bottom portion of it into the staff.

17. Q. The "19" of the same date?

A. The same entry.

18. Q. Have you not tried to dissociate the two figures that made up the changed figure?

A. I have. I have painted out with Chinese white a portion of the tick in the center of the oval, the base of the "2", and leaving a skeleton effect of the original figure "9".

19. Q. Have you done the same thing with the "9", so as to leave the "2", or was that unnecessary?

A. The "2" shows in the white.

By Mr. Edmonds:

I offer in evidence these three photographs as Defendant's Exhibits "AA," "BB" and "CC."

20. Q. Before you announced your conclusion that the figure initially there was a "9", did anyone, —myself or anyone else,—suggest to you in ony way whatsoever what figure might have been there, or what figure we thought was there?

A. No, they did not.

21. Q. Look at page 2066. Is there anything distinctive about the ink that is used on that page?

A. Yes.

22. Q. What is it?

A. It is a bluer color.

23. Q. Is that same ink used on pages 265 and 264, columns "E", "G" and "H"?

A. It is.

24. Q. And page 259, columns "D", "E", "F" and "G"?

A. Yes.

25. Q. Is that same ink used in any records that you find in the X-book dated in 1919 and prior to September 10 of that year?

A. No; not before October 3.

26. Q. Now, will you look at page "X"-2005, and I call your attention more particularly to "Action of Organic Accel." at the top in print lettering, and "Diphenylguanidine" in the column of substances at the left. Are you able to state whether or not "diphenylguanidine" is or is not in the same characteristic printing as "Action of Organic Accel."

A. I am.

27. Q. What is the fact?

A. They are by the same hand.

28. Q. Look, please, at the body of the printing at the bottom of the page opposite, X-2001, and state whether or not that is in the same characteristic printing as "diphenylguanidine" on page X-2005?

A. I also made a study of that previously, and in my opinion it is in the same hand.

29. Q. Will you state your reasons for asserting that these three things were put in the book in the same peculiar characteristic way?

A. The form of the "u," the form of the "n" and the "a," and the general effect of the combination of letters and other identifying points.

29½. Q. What is the distinctive thing about the "u"?

A. There is a little twist at the bottom of it, making a wormy effect. That appears in both entries.

30. Q. You refer to the "3"?

A. It appears in the entry on the side of the column 2005 and also appears in the page 2001.

31. Q. Give another instance. You said there was something peculiar about the "n"?

A. The "n" is made in a contradictory way in the "guanidine," there being two "n's" present. One is made with a cross stroke from the top left down to the right bottom, and in the other instance, from the left bottom up to the right top. I find the very thing to exist and be present in the lettering on page 2001.

32. Q. Now, have you made any photoghaphic studies of these that verify the statements you have made?

A. Yes.

33. Q. Will you state what those are?

A. I had a negative of this page. I printed it, and from the print I cut out sections. That letter is corresponding to the letters of the word "guanidine," and I placed them in similarly alphabetical order, showing those words, which I have here. I then rephotographed them and enlarged them, and you have the enlargement in your hand.

34. Q. Now, take this part at the top of the sheet you have just produced. In the middle is "diphenyl," and under it "guanidine." How did you produce that "diphenylguanidine" in the middle of the upper section?

A. At the top line is the word "diphenyl," as cut out and arranged by me and rephotographed.

35. Q. Cut out from what?

A. From the photograph made at the bottom of page 2001, placed above the word "diphenyl," which

was photographed and enlarged from page 2005. Beneath that word "diphenyl" appears the word "guanidine." The letters in that word were photographed from the lettering at the foot of page 2001, and placed beneath the word "guanidine," it being the bottom line of the "4", showing the cut-out arrangement of the word "guanidine"?

36. Q. I am afraid there is some confusion about this. The second and third lines come from where, of this upper section. From what page of the X-book?

A. The second line came from page 2005.

37. Q. And the third?

A. The third came from the associated letters from 2001.

38. Q. And the fourth?

A. The fourth line came from the arrangement made by me from the photograph of page 2001.

39. Q. You still have not cleared the confusion. As I understand you now, 3 and 4 both came from 2001. Is that the fact?

A. That is not the fact.

40. Q. State what is the fact? Where did the third line come from?

A. The third line is from the column.

41. Q. What column?

A. The column on page 2005.

42. Q. Now, will you show how you built up the first and fourth lines which I understand you got from page 2001.

A. I have them here arranged on the card, where I cut out the letters and pasted them together from the photograph—cut them out from the photograph

and pasted them together on this card, arranging the words as appears on the cards.

43. Q. Have you got the prints from which you cut out the letters?

A. I have.

44. Q. Now, you have presented to me two photographic prints of the matter at the bottom of the page opposite 2001 of the X-book enlarged, and from which it is evident numerous letters have been cut out. Are the letters so cut out the letters which you have pasted on this small white card?

A. They are, with these three exceptions, which are pasted on another card.

45. Q. And this card, with a photographic reproduction of "diphenylguanidine" from page 2005, in the middle, and "diphenylguanidine" above and below it, made up from letters cut out of this larger print, is what you photographed to produce the paper that you first produced?

A. That is right.

By Mr. Edmonds:

I offer in evidence the photographic print first produced by the witness as Exhibit "DD", and the two cards identified by the witness, with "diphenylguanidine" built up on one of them, and three unused letters on the other, are offered in evidence as Defendant's Exhibit "DD-1."

The two prints of the matter at the bottom of page 2001, from which the witness cut out the letters he used in making Exhibit "DD", are offered in evidence as Exhibit "EE".

46. Q. Are you able to state whether or not the same ink was used in making the entry of "diphenylguanidine" in the left hand column of X-2005, in making the entry "Action of Organic Accel." at the top of 2005, and in making the entries that appear on the two sheets X-2001?

A. At the foot of X-2001 would be the lettering. I made a microscopic examination, and in my opinion, it is the same ink. The three are the same ink.

47. Q. Have you made an examination of page 2005, in the effort to detect any evidence of alteration on that page?

A. I have.

48. Q. Did you find anything that suggested an alteration?

A. Nothing whatever.

CROSS-EXAMINATION.

By Mr. Wooster:

X49. Q. Referring to the entry at the foot of column 2034-E, did you explain in your direct examination how, in your opinion, the dark spot inside of the oval got there?

A. It was placed there independently.

X50. Q. Wouldn't that be possible to happen in the case of a person writing the numeral "1"?

A. It might, but I don't believe with this writer.

X51. Q. Do not many people make a slight hook or knob at the top in making the numeral "1"?

A. They do.

X52. Q. And sometimes bear down heavy at the top?

A. Yes.

X53. Q. And sometimes start to make a "1" by a slight upward movement and then down?

A. Yes; and sometimes almost make it look like a "7"; but this writer didn't.

X54. Q. If the writer made the numeral "9" first, why would he make that spot inside of the oval?

A. That we have just been discussing?

X55. Q. Yes. If he wrote "9" first, why would he make that spot in the oval?

A. You mean the original "9"?

X56. Q. Yes.

A. It wasn't there on the original "9", in my opinion. That has been added there to give an appearance of an initial stroke for the figure "2", formed it into a spiral, but it is contradicted by other portions of that oval.

X57. Q. But isn't it also contradicted by the "2" in the column "E", X-2034, opposite "M. G. O."?

A. No. That has been in perfect harmony from beginning to end, the sequence of line and impressions of the ink, is in perfect harmony with what appears there.

X58. Q. But if a man wrote out the numeral "9" there and wanted to turn it into a "2", would he not naturally put the horizontal bar at the base of the "9"?

A. Yes. It is so done in this small sized "2" there, at the lower and end portion of that figure; but when you enlarge it or look at it with a microscope, you can see it is away from the base of that staff.

X59. Q. But why would he then, after putting

that base line on, go up into the oval and put that big gob of ink inside of it?

A. He may have done that first. I don't know that he put that through last. Just how that was recorded, I don't know. But the reason for that is, in my opinion, to give it a little start and take it away, rob it of the "9" appearance and give it the "2" appearance.

X60. Q. But how does filling up the oval help make a "9" resemble a "2"?

A. It gives an excuse for the entering into the line of this lower part of the oval, and then coming out again at that point.

X61. Q. Now, if you start with the "9" originally written, would you say that spot in the oval was not there?

A. No, it was not there.

X62. Q. In which way was your oval made when the "9" was originally written?

A. It was made the same as we see this "9" on the same entry.

By Mr. Edmonds:

X63. Q. According to the "9" in the "19" of the date of the column "E"?

A. With the upward directed stroke, then the loop formed to the left of the staff, and then the lefthand side of the loop going down and turning at the base and coming up and forming a blind loop at the staff.

By Mr. Wooster:

X64. Q. That is, you think it was a clean oval made by the pen going counterclockwise, and then

up to the starting point, and then down, to make the stem or staff?

A. Yes; forming a blind loop at the top of the staff.

X65. Q. You think it was a closed loop originally?

A. Yes, like what appears on this figure "9" of "19"?

X66. Q. Is it possible that the vertical line, including the spot in the oval, and then down to the base of the numeral, was made at one stroke?

A. It is possible that it was made without lifting the pen from the paper, but the angle of the penholder was turned when that was made, and holding the pen at one angle when the tick was made, then turning it and bringing it down toward the writer, and the pressure that would be placed upon it would spread those nibs, as recorded in the photograph.

X67. Q. Would it not spread those nibs just by ordinary pressure, without turning the penholder?

A. No. If the penholder were pressed with a pen held in the same direction that the tick was when the tick was made, then the pen would dig into the paper. The pen nibs would follow each other, and would not travel side by side.

X68. Q. Was the horizontal base line, in your opinion, made with a separate stroke?

A. Yes.

X69. Q. I still do not see that you have given a clear explanation of why a man desiring to change a "9" into a "2", which "9" you say was originally made with a clear unobstructed oval, would after

making the base line at the bottom of the staff go up to the oval and put something inside of it?

A. I don't say that he did make the base staff and then go up to the oval. He may have put that tick there at that point that you refer to inside the oval, before he made the base line, but the purpose of making the tick inside the oval is to make the top portion of the figure "2" spin around, have the appearance of spinning around.

X70. Q. If he were trying to do that, why would he not have made that tick outside to the left of the oval?

A. Because that would not define that spiral. The oval being already there, some use had to be made of it, giving it a finish. If that tick were not inserted, it would look like this one which I have painted, with the painted out tick, which shows a remarkable suggestion of figure "9".

X71. Q. Well, now, could you not by the same process of elimination, paint out the oval and the base line and obtain figure "1"?

A. Yes, you could paint that oval out. I left what was remaining of the oval, that part of the oval which had been untouched by the second operation. That section of the oval shows no nib imprint whatever. That is a portion which I left, showing that it was a portion that belonged to the original figure.

X72. Q. Did you bring the negatives of these photographs with you?

A. I did.

X73. Q. These retouched ones?

A. This retouched one—all the retouching has been done on the paper.

X74. Q. How about the negatives? Have they all been retouched?

A. They are just as pure as when they came from the Eastman Kodak Company.

X75. Q. Referring to the photograph "CC", how did you get the aligning of the individual letters which you cut out to form "diphenyl"? I mean, how did you line up the base of these letters?

A. I ligned it up first in a horizontal line, where this end in the original—

X76. Q. No. This you made up of individual letters, the top one?

A. Where the end in the photograph descended below the base line, there I let the end descend in the arrangement I made, keeping correspondingly as closely as I could to the horizontal base line of the original.

X77. Q. Do I understand you to say that you made up this word "diphenyl" in the top line of this exhibit, by cutting out a lot of individual letters from X-2001?

A. That is right.

X78. Q. Now, with those individual letters cut out, you had no line or base line on which to place them, had you?

A. No.

X79. Q. That is your own idea of the way they should be?

A. My own arrangement as to the base line; for instance, the "yl" on the original entry in the column "diphenyl", the top is on a horizontal line.

X80. Q. You took individual letters from 2001. Where did you get the "yl" from the 2001? You said you got "yl" from 2001. Where did you get it?

A. I can show you on the sheet here.

X81. Q. Where did you get "yl" at the top line of this photograph "CC"? This "yl" doesn't correspond with either of those. Does your "yl" in the first line of this exhibit "CC", which you say you made up from cut-outs on page X2001, correspond with the "yl" on X-2001, opposite X-2001-X, in "phenylhyrozine," "M. G.," or in X-2001, "hexamethylenetetramine"—not quite as good as X-2000-C?

A. Very, very close to the one in the X-2000-C hexa., very close, the "y" and the "l", the "y" extending down below the base line of the "l" with a little curlycue for the base line of the "l"—very close. In the other one the same—that is X-2001-C—the arrangement there is not as close as the other arrangement which we spoke of.

X82. Q. How did you get the slope of the letters in this at the top, "phenyl"?

A. I followed the cut of the base line and on the photograph it shows the clipping, and that shows the base line being a horizontal line.

X83. Q. How did you get that base line?

A. I cut them out as you see the clipping, approximately a horizontal line with the line of writing.

X84. Q. You got those horizontals by hand?

A. Yes.

X85. Q. Not with a "T"-square?

A. No, it is just a freehand arrangement of those letters on this card, and then rephotographed

to this size, the exact duplication of this word "phenyl" appearing in the column, I would never hope to find, but I do find other letters in the body lettering of this man, made in principle the same as the principle in the column lettering. Because I can't at this moment find that "y" is not conclusive that it is not here, because I assure you the cut-out is here.

X86. Q. Now, referring to X-2001, righthand page, would you say that the writer of all that printed at the bottom there had a pretty good idea of writing on a straight line without any ruling, when he printed?

A. The line is very, very clear across the page, with a very good line.

X87. Q. A very good line, wasn't it?

A. A very good line. There are incidental parts of words where the letter would jump above and away from the base line, and sometimes over the base line. The idea is that he keeps his capitals a little above, but he has a system there—a little at the initial line of the word.

X88. Q. A little above?

A. Yes, a little above.

X89. Q. The main line of the word?

A. Yes, the main top line.

X90. Q. In the "diphenylguanidine", and particularly the "guanidine" on X-2005, is not the "g" decidedly dropped below the rest of the letters?

A. Yes, and it rises above. I have just been testifying as to the top portion, how it rises above the following letters. This "g" which you have asked me about rises above and also goes below.

X91. Q. But doesn't the "g" go decidedly below?

A. It does.

X92. Q. If a man came to write this word "guanidine" on X-2005, and found that big letter "D" for "D" shoddy below it, would he not naturally put that "G" down, and then find that he had to go up with the "u" to clear the "D" and the tall loop of the "h" in "shoddy"?

A. I should think he was very shortsighted to do a thing like that, but the "i" in "guanidine" shows that he was not afraid of this, or any letter, being there at all. He simply made it on the base line.

X93. Q. But he cleared the loop of the "h", didn't he?

A. He doesn't touch the "h".

X9. Q. Then he cleared it, didn't he?

A. No, I don't believe the "h" was there when it was put in, so the "h" cleared the "i".

X95. Q. Why did he drop the "g" below the rest of the line and print his "guanidine" horizontally?

A. I suppose for the same reason that the "f" in the word "formaldehyde," the last word on page 2001, was dropped below the line. Nobody knows except the man himself;—the same as the "y" in "yellow" appears on page 2001; the same as "a" in "ammonia" drops below the line; the same as "a" in "accelerator" drops below the line. He had a habit of doing that.

X96. Q. But he has the word "guanidine" on a decidedly upward slant on this "D" Shoddy, hasn't he? That is more or less parallel to a tangent be-

tween the top of the "d" and the top of the loop of the "h". Put your straight-edge on those things and let us see.

A. The "u" descends into the blue line ruled there. The "a" comes away below the blue line. The "n" comes away below the blue line. The "b" rises above the bottom portion of the blue printed line. The "e" comes down to the bottom of the blue line. There is a straight-edge blue line there.

X97. Q. "Guanidine" isn't parallel to it there?

A. You are not fair at all. Unless you use the same principle over on page 2001, dropping your ruler to the base of the initial stroke.

X98. Q. But isn't the word "guanidine" in this X2005 on a decided curve, not on a straight line?

A. Not any more of a curve than is accustomed to be made by the writer in this 2001?

X99. Q. Will you swear that there is not a pronounced curve generally following the outline at the top of the "D" in those letters "g", "u", "a", "n"?

A. The "n" is a little higher at the top than the "u", and also square with the "i", and is as low as the "u"; the "d" comes up at the right, and the following "i" comes down below the "d" at the top line, and the final "e" is lower than the last stroke of the "n".

By Mr. Wooster:

I asked him about "g", "u", "a" and "n".

By Mr. Wooster:

X100. Q. In making up your Exhibit "CC" from this X-2005, you have left out the top of the

"D" and the loop of the "h", have you not? In "'D' shoddy," it is immediately "guanidine."

A. I have not arranged that, no.

X101. Q. Why did you not bring those in?

A. I was interested in showing the identity of the writer of this lettering, and had nothing to do with the "'D' shoddy." That didn't enter into the proposition.

X102. Q. You had no interest in shedding any light on the question whether "'D' shoddy" was written there before those words "diphe[illegible]yl guanidine" were printed in?

A. Yes, I have studied that angle of the question, but that was not the purpose I had in photographing it. Had I been asked to show that portion of it—I was not asked to, but I did enter into that subject, and I find this: that there is considerable space left before the word and above the word "'D' shoddy," and unusually greater space than what appears to be left below there by the same writer. Now, to my analysis of the situation, it would mean that the "phenyl guanidine" was there before the "'D' shoddy" was written.

X103. Q. Then, as I understand it, there is no significance in the dropping of the "g" and the curvature downwards of the "uan" in 'guanidine" relatively to the dropping of the "D" and dropping of the loop of the "h" in "'D' shoddy"?

A. The only significance that has would be, that I find the same characteristics in the writer of 2001, and in that way it is a point of identity.

X104. Q. Do you find the arcing of four letters to a word around two other words in X-2001?

By Mr. Edmonds:

The witness has said the arcing wasnt there.

A. Here are four letters in the word "order." There you find a perfect arcing at the top between the "o" and the "r" (pointing to page 2001).

X105. Q. I am talking about arcing at the bottom of a word clear to something written below.

A. Well, we have no instance of anything being below on this page, except by the same writer, and of course at regular intervals. The writing is made far from the—the writing being far above any writing below, but there we will find a number of places where we find that arcing occurs as a base line. The "zine" on X-2001-C entry, there we have a perfect arc from the "z" to the "e". Here we have one in the figure itself, X-2001-B. There is a perfect arc of greater dimension, greater degree, than appears in the "guanidine" word in question.

X106. Q. But you haven't got three arcs in the same word as you have in this "guanidine" written above the "'D' shoddy," have you?

A. Yes, we have, in "acceleration," where it says "Acceleration very good," on 2001. There we have from the "c" to the "l", from "e" to "a", an opposite curve, in "thio.", one word.

X107. Q. But you have no letters immediately below that which have to be cleared by those arcs in "acceleration"?

A. No; but that would show it was the nature of the writer to create those arcs. Now we have another one in "quinoline," X-2001. We have a decided arc there. We have another one in "acceleration," on

2001. The fact is, this is full of arcs at the base and at the top of the line. "The acceleration very good" —There it looks like a snake or a worm moving right along with an undulating motion.

By Mr. Edmonds:

X108. Q. I neglected to ask you about "CC" at the bottom. That is a photograph made up like the section at the top, namely, a photograph of the action of organic accelerators, at the top of page 2005, and under it the same thing, built up from letters on X 2001?

A. And rephotographed and enlarged, yes.

X109. Q. On looking at "diphenylguanidine" at page 2005, through the microscope, it is evident, is it not, that both of the two "i's" in "guanidine" project below the blue line on the page?

A. It is decidedly below.

X110. Q. And the "d" between them is a little above the level of those two "i's"?

A. The "d" is considerably above the level of those two "i's".

X111. Q. Can you tell which of the two "i's" come down lower, or are they both the same?

A. The one following the "d" I should say goes a little below, if anything.

X112. Q. Both are quite visibly below the line?

A. Definitely, positively below.

X113. Q. There is one more question I want to ask you about the changed "9" on page 2034. In doing the retouching incident to making that into the "2", in accordance with what you have arrived at, as your conclusion as to how it was done, was any

retouching done to the loop of what was initially the "9"?

A. Yes.

X114. Q. Where, exactly, was that retouching done?

A. I suppose I had already testified as to that. At the base of the line, a line has been drawn directly toward and entering into the staff. That is drawn in a horizontal manner with the pen held off to the right, and directly opposite to the way in which the down-stroke was made.

X115. Q. Is there evidence of retouching of the top portion of the loop of the "9"?

A. No.

X116. Q. Will you get your high-power microscope and let Mr. Wooster look at anything he wishes to see?

A. Yes, sir.

(The Court and Mr. Edmonds and Mr. Wooster examined X-2034-E with the microscope.)

By Mr. Wooster:

X117. Q. What is the power of that glass as just set to examine this entry?

A. It is about twelve diameters.

X118. Q. Will you now set it on the other one, the word "guanidine," on 2005?

(The witness does as requested and the Court examines the same.)

X119. Q. What is the make of instrument which we have just used?

A. A Zeiss binocular.

(The Court and counsel also looked through this instrument at the entry on X-2005 of "diphenylguanidine.")

X120. Q. Did you say in your direct examination what the scale of enlargement was of the three photographs, Exhibits "AA", "BB", and "CC"? If not, will you so state?

A. It was as much as I could make it with the bellows I had. About six or seven times larger than the original.

X121. Q. How about Exhibits "DD" and "EE"?

A. About three or four times as much.

X122. Q. That is the one where you collected the letters for "diphenyl" and the words diphenylguanidine" and "guanidine" and "Action of Organic Accel."?

A. Yes, and they are enlarged in the same relative proportion, looking from the side of the column at 2005 and 2001.

X123. Q. What is the scale of enlargement of the sheets, including the cut itself, from X-2001?

A. That is about double the size, or as much as I could make it on an 8 x 10 plate.

By Mr. Edmonds:

At one time, two of the pages in this X-book were out of the book, and their whereabouts were unknown for a period of probably a couple of months; then they were found and were put in the book and are now pasted in here, and both sides, as I understand it, agree that these are the orig-

inal pages, and that Mr. Weiss's handwriting is on this page which was at one time missing. I would like to ask if the plaintiff makes any point whatever of the fact, or will attempt to make any point of the fact, that the pages were at one time out of the book. If they do, I shall have to put on a couple of witnesses who will testify in that connection. I can do that now; or if counsel do not care to state whether they will make any point about that, then I shall let the matter rest for the present.

Mr. Wooster has asked me to stipulate that one deposition taken in the National Aniline Case by the plaintiff might be used here, and to avoid the inconvenience of taking that deposition or bringing the witness here, I agreed to it. If that deposition is to be offered in evidence in rebuttal, then I must meet the situation.

By Mr. Wooster:

There is an issue raised here as to whether or not the words "diphenyl guanidine" were written on that X-book page 2005 before or after the date when "'D' shoddy" was written under it, by Mr. Weiss. The deposition that Mr. Edmonds just referred to is that of Mr. Vaill, who testified in substance that as late as May 18, or thereabouts, 1922, when he examined that book, he had not noticed those words "diphenyl guanidine" on that page, X-2005, and that the purpose of his examination of the book at the time was to find the several references in it to diphenyl guanidine. The plaintiff will offer that stipulated deposition of Mr.

Vaill. Offhand, I do not recall that there is any discussion in that as to who took the pages out, or when they came back, the fact being, as I understand it from the National record, not having been in that case myself, that the X-book pages were searched for up to sometime before the trial, and at or about the time of the trial were returned and put in the book, and the book the way it is now was brought into court. I see no point being raised here about the period when those pages were out.

By Mr. Edmonds:

There is a very definite point, in this respect: The date when this Mr. Vaill saw the book is fixed beyond question, and it is possible to fix by two witnesses who are here beyond any question whatever that the absence of these two pages was noted two days before that day when Mr. Vaill saw the book. So that the pages which he says he would have seen had they been there, and would have seen "dihpenylguanidine" on it had it been there, were not in the book at that time. So I must prove by these two witnesses that the pages were not in the book, if Mr. Wooster proposes to use this deposition of Mr. Vaill, and to make a point of the fact that the pages were out and might have been offered at that time.

By Mr. Wooster:

I propose to offer that stipulated deposition of Mr. Vaill, and it can be considered as preiously offered by plaintiff. I also expect to call other witnesses in corroboration of that.

JOHN YOUNG, a witness called on behalf of defendants, having ben duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. You are in the employ of the National Aniline & Chemical Company?

A. I am.

2. Q. And working directly in connection with rubber accelerators?

A. Yes, sir.

3. Q. That has been your business for some time past?

A. Since June, 1921.

4. Q. Does the National Aniline & Chemical Company sell diphenylguanidine?

A. They do.

5. Q. Will you state whether or not the sale of diphenylguanidine by that company preceded or succeeded November 12, 1921?

A. It preceded that date.

6. Q. Were you at the meeting of the American Chemical Society in Philadelphia, early in September, 1919?

A. I was.

7. Q. At that time you were connected with what company?

A. The Firestone Tire & Rubber Company.

8. Q. And associated with whom, in that position?

A. I was chief chemist there at that time.

9. Q. Was Mr. Norman Shepard associated with you?

A. He was working under me.

10. Q. That is the Mr. Shepard who testified in the Dovan suit against the National Company?

A. The same.

11. Q. Was the Kratz paper read at that September 1919 meeting, the subject of discussion between you and Mr. Shepard?

By Mr. Wooster:

Objected to as calling for hearsay, and as incompetent.

By the Court:

It is a mere question as to whether it was discussed, not the subject matter of discussion.

By Mr. Edmonds:

12. Q. Was it the subject of discussion?

A. We discussed the paper after we returned.

13. Q. Immediately after your return from the Philadelphia meeting?

A. Possibly the next day.

14. Q. When Weiss applied to the Firestone Company for employment, and talked with Shepard and filled out the application that has been presented here, was that reported to you at about that time?

A. Yes. I asked Dr. Shepard to interview Mr. Weiss, and after the interview he came back and showed me the application.

15. Q. Now, I show you the 2000-X-book of the Republic Rubber Company. Will you state when you first saw that book?

A. I first saw this on May 4, 1922.

16. Q. Where?

A. In the laboratory of the Republic Rubber Company at Youngstown.

17. Q. When did you see it next after that?

A. On May 8, 1922.

18. Q. Where?

A. In the board room of the National Aniline & Chemical Company, in New York.

19. Q. Did you have anything to do with the sending of that book from Akron to New York between those two dates?

A. When I was at Youngstown on May 4th, I discussed with Mr. Zieme, who was then chief chemist, the records which the Republic Rubber Company had, and he offered to send this book with Mr. Eaton to New York for examination by the National Aniline & Chemical Company.

20. Q. Was that done?

A. That was done.

21. Q. Eaton brought the book from the Republic to New York?

A. Yes.

22. Q. At the time you saw the book when Eaton brought it to New York, who saw it with you?

A. Mr. Barrows and Mr. Replogle were present, as well as myself and Mr. Eaton.

23. Q. Mr. Barrows, who is here present?

A. Yes.

24. Q. You four?

A. Yes.

25. Q. Any others?

A. Not that I recall, no.

26. Q. Do you recall whether or not at the time when you four were examining that book on the date you have named, it was ascertained that something was missing from the book?

A. Yes, I recall that very well. There were two pages missing.

27. Q. Did the absence of those two pages, when discovered at that time, appear to have been known to any one of you, or was it a surprise to all four of you?

A. It was a surprise to everybody.

28. Q. Eaton didn't know it any more than the rest of you?

A. Not that I recall, no.

29. Q. Can you state definitely who discovered the absence of the pages?

A. I believe that Mr. Barrows had the book in his hands when it was being examined, and it was discovered, but I wouldn't be absolutely certain. It was either Mr. Barrows or Mr. Replogle.

30. Q. In turning over the pages, somebody noted that one was missing and called attention to it?

A. Yes, sir.

31. Q. What was done thereafter?

A. It was decided to have this book photographed, to show that the pages were missing.

32. Q. Did you have anything to do with that?

A. I accompanied Mr. Eaton to a photographer, on 42nd Street, New York, where the book was photostated. While Eaton arranged to have the pictures made, the book was in his possession.

33. Q. The book remained in Eaton's custody throughout the whole time, so far as you know?

A. Yes. Mr. Eaton and myself both waited in the room while the book was being photographed.

(No cross-examination).

FRANK E. BARROWS, a witness called on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Edmonds:

1. Q. State your residence and occupation.

A. I reside in Glenwood, New Jersey. My occupation is attorney at law.

2. Q. Your firm is attorney for the National Aniline & Chemical Company?

A. Yes; it has been for several years past.

3. Q. You heard Mr. Young say about a meeting at the National Aniline & Chemical Company's office in May, 1922. Do you recall that meeting?

A. Very well, indeed.

4. Q. You were present?

A. Yes.

5. Q. Who else was present?

A. Mr. Replogle, Mr. Eaton and Mr. Young.

6. Q. Will you state what the date was?

A. May 8, 1922.

7. Q. Can you fix the date of that meeting beyond any question whatever?

A. Positively.

8. Q. By reference to what?

A. To my time-sheet entries showing the work which I was doing in my office on that date.

9. Q. I am advised by counsel for plaintiff that they will not question the date when that occurred. Is it your recollection that those present at that meeting were you, Mr. Replogle, Mr. Young and Mr. Eaton?

A. That is correct.

10. Q. Will you state what occurred at that meeting with reference to the examination of the Republic 2000 X-book, and finding that certain pages were absent?

A. I might preface that by stating the reason for this meeting and for the examination of the book. When the Weiss patent here in suit was granted, the National Aniline Company was manufacturing and selling D. P. G., and was in the position of an infringer of this patent. The Dovan Company approached the National Aniline Company, seeking to have that company take a license and pay a large sum of money for it.

11. Q. I would omit any detail of that unless you think it necessary.

A. I was asked by the company as to the validity of the patent, and for advice as to what action they should take regarding it, and in the course of the investigation which I immediately started, I obtained the file wrapper of the patent from the Patent Office, and learned from it of the work that Weiss claimed to have done at the Rubber Company in 1919, and immediately had an investigation started to check up his work. On learning that Mr. Eaton

was familiar with it and knew of the records, I arranged to have Mr. Eaton come to New York for a conference and bring the records with him. At that conference, I personally examined with the greatest care another X-book, so far as the entries had any date relevant to the work of Mr. Weiss or his predecessors. I went over this book page by page with Mr. Eaton, and had him explain the names of substances that I did not recognize, and we looked particularly for records that Mr. Weiss made prior to the date of the Kratz paper of September, 1919. I recall very distinctly that we found only three entries prior to that date, and one of these entries had evidence of a change of date—

By Mr. Wooster:

I object to that. This gentleman is of counsel in this case, and he seems to be giving a brief here instead of answering the question that he was asked. I move to strike this answer out.

By the Court:

Yes, a good deal of that is not responsive, and we will strike it out. You may renew your question, if necessary, Mr. Edmonds.

By Mr. Edmonds:

12. Q. Will you state the circumstances in connection with this meeting at the office of the National Company, when it occurred, who was there, and what happened in the way of discovery that certain pages of the book were missing?

A. This meeting took place at the office of the National Aniline & Chemical Company, New York.

It began in the morning and continued most of the forenoon of May 8, 1922. It had been arranged for by myself, through the National Aniline & Chemical Company, in order to obtain information about the work of Weiss at the Republic Rubber Company, to check the allegations that Weiss had made in affidavits filed in the Patent Office during the prosecution of his application for the patent in suit. There were present at this conference, Mr. Eaton, an employee of the Republic Rubber Company, who brought with him the 2000 X-book, Mr. Replogle and Mr. Young, of the National Aniline & Chemical Company, and myself, who at that time had been asked for an opinion on the validity of the Weiss patent. My examination of this book was for the purpose of obtaining information to advise the company. I examined the book carefully, page by page, and had Mr. Eaton explain to me terms that I did not recognize, and carefully noted the dates, and looked particularly for entries by Weiss relating to diphenylguanidine prior in date to the Kratz paper of September, 1919.

I found on page X-2006 one such entry, and at the bottom of the page a cross-reference to X-2005. I looked to see what the entry on X-2005 was, thinking it might be diphenylguanidine, and I found there was no such page in the book, that the immediately preceding page was X-2004. Then it occured to either Mr. Replogle or myself—I forgot which—to again examine and see if any other pages were missing. This we did throughout the entire book, page by page. I noticed that page X-2008 was also missing. We noticed also that these two pages were part

of the same sheet on opposite sides of the stitching by which the leaves were held in the book. So that the sheet itself as a whole was missing.

I have a very definite recollection of the circumstances surrounding this discovery.

13. Q. I wish you would fix the date in a way that fixes it very definitely.

A. I fix that date by my time-sheet entry, showing the conference with Mr. Eaton and Mr. Replogle, and by a letter which I dictated that same day, late in the day, dated the following day, in which I stated the circumstances of the conference in detail.

14. Q. Have you got a copy of that letter with you?

A. I have both the original, which I obtained from the files of the National Aniline & Chemical Company and our file copy from our own files, in our own office.

15. Q. Is there any reason why the original should not be offered in evidence?

A. None that I know of.

By Mr. Edmonds:

I offer in evidence the letter just identified by the witness as Exhibit "FF."

By Mr. Wooster:

I concede the date of the letter, but I object to the letter as a whole, and the contents thereof, as wholly self-serving.

By Mr. Edmonds:

Will you concede that the conference took place.

By the Court:

There is an admission that there was a conference on that particular date. We will sustain the objection and note an exception.

By Mr. Edmonds:

I would like to withdraw the exhibit, if that concession has been made. I do withdraw that exhibit.

By Mr. Edmonds:

16. Q. Did you have anything to do with the photographing of the X-book, as has been stated?

A. It was at my request that the photographs were made, and I arranged to have them made at the 42nd Street Commercial Studio, which makes most of the prints for our office.

17. Q. Have you got with you the photostats that were made at that itme?

A. I have one set, one of the five sets that were made. We had two complete negative sets of the first seventy-eight pages, and three positives.

18. Q. Does that photostat that you have show that the page 2005 was missing?

A. It does not show it as to X-2005, because that sheet was torn apart for use in the preliminary injunction proceedings which subsequently took place, and where we used that page attached to one of the affidavits. The page was subsequently reassembled in the book, but page X-2007, the original print show-

ing that the page was missing, is in the same form it was at the time the photostat prints were made. These prints had been in our office prior to the National Aniline trial, for a court exhibit in that trial, and have been in our office, under my personal custody, since that time.

19. Q. How does the photostat show that page 2008 was missing?

A. It shows on one side of X-2007. On the other side of the sheet it shows X-2008 as it now appears in the X-book, when 2008 has been returned to it.

20. Q. Does one photographic copy of the X-book show page 2007 and no page returned. It was a page from 2007. Is that a fact?

A. It shows 2007 was on the opposite side, or is now opposite, X-2008.

By Mr. Edmonds:

I do not think it is necessary to present that in evidence, but I submit it for the inspection of counsel for the plaintiff.

21. Q. Now, will you state how long after that date, when the pages were discovered to be missing, they continued to be missing?

A. I had occasion to examine this book again very carefully on June 2 or June 3, 1922, at a time when a motion for preliminary injunction had been brought, and we were required to show cause why that motion should not be granted. I went to Youngstown and there examined the book, and spent most of the day conferring with Mr. Eaton and Mr. Zieme, and prepared an affidavit for Mr. Eaton as

the result of that conference. In the course of that conference, I had occasion to go over the X-book carefully, and I know that the same page, X-2005, was missing from it at that time.

22. Q. Was the absence of the page a subject of discussion at that meeting?

A. Very much so, and it was a subject of discussion from the standpoint of the affidavit and the fact of its being missing was included in that affidavit as the result of my personal observation of the book at that time.

23. Q. Have you fixed that date?

A. I fixed that date by reference to my time-sheet, showing that I was in Youngstown at that date, and that I had a conference with Mr. Eaton and prepared the affidavit on that date.

By Mr. Edmonds:

Perhaps Mr. Wooster will be good enough to concede that date is correct.

By Mr. Wooster:

Yes.

(No cross-examination).

By Mr. Edmonds:

Mr. McWhorter reports, in answer to the request of counsel for plaintiff, that tube-A, produced by him in the course of his testimony, was found to weigh one pound and seven and three-quarter ounces, and that tube-B was found to weigh one pound eleven and one-half ounces, without the valves.

ERNEST R. BRIDGEWATER, a witness called on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. Will you state the place of your residence?

A. Wilmington, Delaware.

2. Q. And your occupation?

A. Chemist.

3. Q. In the employ of what company?

A. The Du Pont de Nemours Company.

4. Q. How long have you been in that employ?

A. About a year and nine months.

5. Q. Will you state your employment prior to that?

A. Prior to that, I was with the Firestone Tire & Rubber Company, in charge of , prior to that, tire compounding, and prior to that with the B. F. Goodrich Rubber Company, in charge of hose and belting compounding.

6. Q. For how long?

A. For about two years with the Firestone Company, a little over two years, and for about three years with the Goodrich Company.

7. Q. When did you graduate from college?

A. In 1918.

8. Q. Since then, has all of your work been connected with the rubber industry?

A. With the exception of a brief period when I was in the service.

9. Q. You took a degree in Chemistry?

A. I did.

10. Q. And the chemistry of rubber has been your special field of activity?

A. That is right.

11. Q. Will you state what a disubstituted guanidine is?

A. It is a compound which contains a guanidine nucleus and in which two of the hydrogen atoms have been replaced by another group.

12. Q. Will you state as well as you can how many disubstituted guanidines there are?

A. I don't know how many there are; probably not more than 100 have ever been prepared—I should say between 50 and 100. Of course, there would be many times that many possible disubstituted guanidines could be prepared if there were any occasion for it.

13. Q. Many hundreds of them?

A. Yes; I should say 500 or 1000.

14. Q. It appears that some disubstituted guanidines are accelerators of rubber vulcanization?

A That is right Some of them are very good accelerators

15 Q. Are all of them accelerators with rubber?

A. No, they are not.

16. Q. Will you name some of them that are not?

A. A few which have been tested in my laboratory and which are not, are dicarbethoxyguanidine, hydroxymethylcyanoguanidine—

By Mr. Wooster:

I object to this line of examination as not an issue involved in this case. The proof here is that the defendant used diphenylguanidine and it is not denied that that is a disubstituted guanidine, and therefore I think it is entirely immaterial and outside the issues in this case for an expert like this witness to say what other disubstituted guanidines may or may not be accelerators in the vulcanization of rubber.

By Mr. Edmonds:

This plaintiff has notified the defendant, as stated here in court, that it relies in this suit not only on the claims of this patent that cover diphenylguanidine, but also on certain other claims that are stated to cover all disubstituted guanidines, and for that reason we are certainly at liberty to present defenses applicable not only to these broad claims as well as to defenses applicable to the whole patent. In other words, the choice rested with plaintiff as to what it would prosecute this defendant on, and it made its choice, and now has to abide by it.

By Mr. Wooster:

The simple fact is that diphenylguanidine is a disubstituted guanidine, and therefore the defendant infringes the claim covering the disubstituted guanidine accelerator, not merely any disubstituted guanidine. It is also admitted that the defendant specifically uses diphenylguanidine, and therefore it infringes a disubstituted guanidine accelerator claim. Defendant is not here

for either using or making diphenylguanidine generally, but using it as a rubber accelerator and making the resultant product. He didn't choose to use other things that this witness and the art generally knew of that they make without disubstituted guanidines. I think your Honor should exclude all of this.

By the Court:

In order to save time, we will admit this and rule upon it later.

A. Dibenzoylguanidine; bi-thio-carbethoxyguanidine; di-sulphophenylguanidine; di-nitro-dibenzoylguanidine. That is all of the disubstituted guanidines which I happen to have tested and which are not accelerators.

17. Q. So that you have now named six substances that are disubstituted guanidines and are not accelerators of rubber vulcanization?

A. Yes.

18. Q. There has been some reference in this record to diarylguanidines, why I am sure I don't know, because there is nothing stated about it in the patent; but because of that, I wish you would state whether all of these six substances that you have named are or are not diarylguanidine?

A. Five of them are not, one, disulphoguanidine is.

19. Q. I show you Defendant's Exhibit "O," a translation of a magazine article of Duboc. Have you examined that, and if so, state what it is, what it covers?

A. Yes, I have read this article. It is one pub-

lished by Duboc, who is the editor of Le Caucho uc et Guttapercha, which is the leading French magazine on rubber. It is a general review of vulcanization accelerators, referring chiefly to guanidines and guanidine derivatives, and mentioning a large number of compounds of this class, which Duboc states have been investigated and found to be accelerators.

20. Q. This article refers in a long list of guanidines and guanidine derivatives that are said to be accelerators, to a substance diaminoguanidine?

A. Yes, sir, that is right. I noted that reference.

21. Q. Will you state what you know about the accelerating value of this substance?

By Mr. Kennedy:

So as to save the time of the Court, yesterday, in the course of the examination of the witness McWhorter, anticipating, and in fact knowing then, that tests would be referred to, I noted on the record an objection that I note here, and which may run without repetition, I assume, to any testimony here by this witness as to so-called ex parte tests. As I stated here, we were not invited to be present at any such tests, and they were not conducted in our presence.

By the Court:

We will admit them subject to your objection.

A. Yes. I have tested diaminoguanidine, using it in the form of its bicarbonate salt, since the free base is unstable, and I find it to be an accelerator.

I have here a record of that test. The compound which I have tested will not vulcanize in sixty minutes at 286 degrees Fahrenheit, in the absence of an accelerator; but in the presence of the bicarbonate salt, of diaminoguanidine, it had a tensile strength of 1410 pounds, when vulcanized for 60 minutes.

22. Q. Are you now referring to a record of the test you made with diaminoguanidine?

A. I am.

By Mr. Edmonds:

I offer this record in evidence as Exhibit "GG."

By Mr. Wooster:

The same objection is made by the plaintiff.

By the Court:

This is all in the line of tests. The objection is overruled and exception noted to plaintiff.

By Mr. Wooster:

I desire to further state that the Duboc article referring to diaminoguanidine is pleaded as anticipatory in the answer. This witness has just stated that he did not test that substance, but did test the bicarbonate salt of diaminoguanidine, whatever that may be. That matter is not pleaded in the answer, and plaintiff objects, on the ground that it is entirely outside of any issue raised here in the pleadings.

By Mr. Edmonds:

23. Q. Will you state why it was—

By the Court:

He has already stated.

By Mr. Edmonds:

24. Q. What was it that led you to try to test this unstable compound in the form of this bicarbonate salt?

By Mr. Wooster:

I make the same objection. He is now trying to build up the publication beyond what it shows on its face.

By the Court:

The objection is overruled and exception noted.

A. In the first place, that is the usual way of handling unstable chemicals in the form of a salt which will decompose, producing the pure chemical at the proper time; that is, in this case, when the rubber is heated for vulcanization. However, if I had not known that—I recall that Twiss, in an article published at about the same time mentioned tests on aminoguanidine as an accelerator, and stated that he used it in the form of its bicarbonate salt, because the free base was unstable.

By Mr. Wooster:

I make the same objection to that, as aminoguanidine is not a disubstituted guanidine; hence, outside any issue proposed to be raised here.

By the Court:

This last is a mere illustration.

By Mr. Edmonds:

25. Q. The Twiss article, to which you refer, is Exhibit "O" in this case?

A. Yes, it is.

26. Q. Have you got test sheets similar to Exhibit "GG," with reference to tests that you made on each of these substances that you told about, which you said were disubstituted guanidines and not accelerators?

A. I have. Here they are.

By Mr. Wooster:

I make the same objection.

By Mr. Edmonds:

27. Q. Does each of these bear the date when you made the test?

A. They do.

By Mr. Edmonds:

I offer in evidence the test sheets just referred to by the witness, to be marked Exhibit "HH."

By the Court:

The objection heretofore made by the plaintiff is overruled and exception noted.

RECESS.

AFTERNOON SESSION.

Wednesday, October 14, 1925.

E. R. BRIDGEWATER resumes the stand.

DIRECT EXAMINATION (Continued)

By Mr. Edmonds:

28. Q. Will you look at the 2000 X-book of the Republic Company, page 2006, and note the test recorded there in the column labeled H, and state whether or not the test recorded there as made on the date indicated would have indicated to the man who made the test that there was any superiority of D. P. G. over T. P. G.?

A. May I refer in answering that question to other tests shown on the same or preceding page?

By Mr. Wooster:

Objection. That entry should speak for itself, and it should not be necessary to bring in extraneous evidence of *ex parte* tests made by this witness, without invitation to plaintiff.

By the Court:

Your objection is to the first question asked, that is, as to what the test would indicate?

By Mr. Wooster:

My objection is that the witness should testify from what he sees in the book, not from something else he did outside of the book.

By Mr. Edmonds:

That is what the question asks him to do.

By Mr. Wooster:

Then the witness asked if he could refer to his own tests.

By the Court:

No; I understood him to say other tests in the book.

A. I find on page X-2005, column H, a test on a formula, which is the same as the one shown on X-2006, column H, excepting that the one on page X-2006 contains 2 per cent of diphenylguanidine, while the one on page 2005 contains no other accelerator, excepting one per cent of lime. There is also a difference of 2 per cent in the barytes content, which was apparently made so that both of the formulas would add up to 100, barytes being an inert filler. It appears from these tests that the addition of 2 per cent of diphenylguanidine produced an increase of the tensile strength of 105 pounds. I also find on page X-2006, column blank—it is not numbered—a test on a formula of approximately the same general nature as the one I just referred to. The difference is that 5 pounds of rubber and 20 pounds of barytes are replaced by 23 pounds of additional shoddy. There is also a difference of 1 per cent in the sulphur content.

By Mr. Wooster:

29. Q. More or less sulphur?

A. There is more sulphur in the compound I referred to now than in the one I referred to previously. In column B on X-2006 are shown tests on this same formula, with 3 per cent of triphenylguani-

dine in place of 3 per cent of litharge. Litharge is a popular inorganic accelerator. The replacement of 3 per cent of litharge by 3 per cent of triphenylguanidine resulted in an increase in the tensile strength from 430 pounds to 730 pounds, or a net increase of 300 pounds. I should certainly say, from the fact that replacing litharge by triphenylguanidine produced this large increase in tensile strength, while in a very similar compound adding diphenylguanidine and not taking out any other accelerator produced an increase in the tensile strength of only 105 pounds, triphenylguanidine was a better accelerator to use in this type of stock than diphenyl. basing my conclusions, of course, only upon the tests and conditions of vulcanization recorded on these pages.

By Mr. Edmonds:

30. Q. Is this conclusion that you have expressed drawn from only what is recorded on these pages you have referred to, verified by any tests that you yourself have made; and if so, state what they are?

A. The conclusion that I have just drawn was made without reference to any test that I have made. I have, however, made tests on this same compound shown on page X-2006, column H. Inasmuch as C-shoddy was made only by the Republic Rubber Company for their own use, and is not now available, I inquired of Mr. Seth Clark, who was manager of the development department at the Republic Company at the time these tests were made, what present day shoddy would be its equivalent. He informs me that Philadelphia No. 69 is made from the same

scrap, and he judges it to be substantially equivalent. I therefore used Philadelphia No. 69 in repeating this test. I find that this compound has an average tensile strength, when vulcanized under conditions indicated in the X-book, of 712 pounds per square inch, which checks the results shown in the X-book, 720 pounds per square inch, very well—remarkably well.

I also tested this same compound, leaving out the accelerator altogether, and making no other change. I have here a test sheet marked "Ed-1," showing the result of my test on the compound as it appears in the book, and a sheet marked "Ed 1-A," showing result of my test of the compound with the diphenylguanidine left out. With the diphenylguanidine left out, the tensile strength is slightly lower, 663 pounds, but within the limit of experimental error.

I also tested this same compound, replacing the 2 per cent of diphenylguanidine by triphenylguanidine. The result of this test is shown on the sheet which I have here, marked "Ed-1B." This compound has an average tensile strength of 756 pounds, which is higher—but still within experimental error—than the result reported in the X-book. I conclude from these tests that this test could not have indicated to anyone that D. P. G. was a better accelerator for use under these conditions and in this stock than T. P. G.; or, for that matter, the compound containing the D. P. G. better than the one containing no accelerator at all.

By Mr. Edmonds:

The test sheets just referred to by the witness are offered in evidence as Defendant's Exhibit "II."

By Mr. Wooster:

Same objection, and exception.

By the Court:

By that you simply mean you object to the use of any test at all, and not to the fact that the test was made pursuant to hearsay testimony as to the components. I was looking for an objection upon that ground, and would have sustained it on that. If you simply make the subject matter of your objection the introduction of any testimony as to tests of those formulas, I would overrule your objection. I think, if there is objection made to it on the other ground, I will have to sustain it.

By Mr. Edmonds:

On what grounds, if your Honor please?

By the Court:

On the ground that he took other material which a third party informed him was substantially the same. Until the ground were laid, that would not be competent at all.

By Mr. Wooster:

If your Honor please, I intended to raise that objection after cross-examination of this witness.

By the Court:

But after the thing is once admitted, it is admitted on the face of the situation as it exists at the time it is offered, and a motion to strike out does not quite cover the same ground. If the objection is made now, though, I will have to grant it.

By Mr. Edmonds:

May I say a word on that, if your Honor please? This C-shoddy that was used in the Republic Company away back in 1918 is a thing that is not obtainable at the present time. You can't buy it from the Republic Company or anyone else, so the witness had no choice—

By the Court:

That is all right about that part of it. He would have to take what he had to make it, but if he has no knowledge of the identity of that with which he replaced it, and there is no evidence of the substantial identity, then the test is worthless, so far as a matter of proof is concerned.

By Mr. Edmonds:

Now, this information that he referred to as having got from Mr. Clark, he is right here and of course can be put on the stand, if that is the only ground of objection to the testimony. I have no doubt, though, that Mr. Wooster would concede that if Mr. Clark were put back on the stand, he would say that to the best of his knowledge this Philadelphia shoddy number so-and-so is the same as the Republic Company's C-shoddy.

Now, I would like to put Mr. Clark on the stand, if you make any point about that. Of course, Mr. Clark can only give his opinion, but it is a pretty accurate opinion, because he is a man that is pretty accurately familiar with it.

By the Court:

Of course, he would have to show his familiarity with the other.

By Mr. Edmonds:

He is sufficiently familiar.

By the Court:

If there is a definite offer placed upon the record to establish by a competent witness who had knowledge of the identity of the two products, I will accept it out of order, overruling the objection—of course, with leave to counsel to renew the objection in case the offer is not sustained.

By Mr. Edmonds:

I do make that offer right now. Mr. Clark is here present, and can take the stand at any minute and tell all about it. I would like to omit some of these very minute matters; it would help us to get along a little faster.

By Mr. Wooster:

Plaintiff objects to the answer, as hearsay, and also repeats the objections and exceptions heretofore taken as to the weight to be given ex parte tests. If Mr. Edmonds desires to examine Mr. Clark on shoddy, he may do so.

By Mr. Edmonds:

I will have to do so, though I hate to use the time on such things.

By Mr. Wooster:

I move to strike the answer out.

By the Court:

In view of the offer to follow this by proof as to the identity of the shoddy used in the test with that formerly used by the Republic Company under the name of C-shoddy, I shall overrule the objection, noting an exception to the plaintiff; of course permitting the plaintiff's counsel the right to further object, in case that offer be not met by the testimony.

By Mr. Edmonds:

31. Q. Now, Mr. Bridgewater, will you consider the test on shoddy recorded in column A on page 2042, and state whether you have made a similar test there, and what conclusion you have drawn?

A. Yes, I made similar tests on the compound shown on page X-2042, column A. I have here test sheet marked "Ed 2," showing the result of that test. This compound has a tensile strength of 620 pounds per square inch, which is the same as that shown in the X-book. I also tested this same compound in the absence of any accelerator, excepting lime, and find that it then has a tensile strength of 487 pounds per square inch. This test is shown on the sheet which I have here, marked "Ed 2-A." I further tested the same compound, replacing the diphenylguanidine by triphenylguanidine.

The result of this test is shown on the sheet which I have here, marked "Ed 2-B." In this case it is apparent that the diphenylguanidine improved the quality of the rubber over what was obtained without any accelerator at all, but it is equally apparent that under the conditions of vulcanization which are shown at the bottom of this column A, T. P. G. gives a still further improvement. I would conclude from this that no conclusion could be drawn which would show any advantage of D. P. G. in this compound over the previously known T. P. G. One who was familiar with the effect of T. P. G. in this compound would have recognized this as a poor result, and, of course, attribute the quality of the result to the accelerator use.

By Mr. Edmonds:

I offer in evidence the test sheets to which the witness has just referred, as Defendant's Exhibit "MM."

By Mr. Wooster:

Same objection and exception, and motion to strike, by plaintiff.

Now, in that one there seemed to be a different shoddy used there, as I understand it.

By the Witness:

May I add to my answer an explanation of that—I neglected to do so.

By the Court:

You may.

By the Witness:

In making these tests I used Philadelphia Lehigh Reclaim in place of the G-shoddy, G-shoddy being no longer available, and since I am informed by Mr. Clark that Philadelphia Lehigh is substantially equivalent to the G-shoddy which the Republic Rubber Company was producing in the early part of 1919.

By Mr. Wooster:

I object to this last statement, as hearsay, and move to strike it out.

By Mr. Edmonds:

I note on the record that this is to be followed by a statement of Mr. Clark as to the equivalency of the shoddies referred to.

By the Court:

In view of the offer, we make the same ruling as with regard to the other test.

Exception noted to Plaintiff.

By Mr. Edmonds:

32. Q. Mr. Bridgwater, when Mr. Whitby was on the stand he referred at some length to the various advantages of D. P. G. and T. P. G. in rubber acceleration. Will you state your views on that subject?

A. Yes, I will.

By Mr. Wooster:

(To the witness): Don't read from notes, please.

A. (Continuing) I am requested by Mr. Wooster not to refer to notes. I have notes before me concerning a number of statements which Mr. Whitby made, and upon which I wish to express my opinion. I am afraid I cannot recall all the points he made, many of which I do not agree with, without reference to notes.

By Mr. Wooster:

33. Q. You may use the notes for points, but not to read your answer from.

A. Dr. Whitby stated that "it"—referring to diphenylguanidine—"that various advantages as a commercial matter aside from those effected in vulcanization which I think no other accelerator available at that time possessed in the same measure." Dr. Whitby is mistaken in this. Triphenylguanidine has all of these advantages in equal or greater degree. Specifically, he says, diphenylguanidine is not poisonous; neither is triphenylguanidine. He also states that diphenylguanidine is insoluble in water, and can therefore be used in open steam cures; triphenylguanidine is equally insoluble in water,—although, as a matter of fact, it is not essential that an accelerator which is to be used in open steam cures be insoluble in water. Hexamethylenetetramine is very soluble in water, and has been used in open steam cures, especially inner tubes, for the last eight years at least, and is still so used by many of the largest rubber companies. He also states that D. P. G. is soluble in rubber, and therefore disperses well. This is likewise true of T. P. G. to an equal degree. He states that D. P. G. is stable and can be kept indefinitely. The same statement is true of T. P. G.

He states that D. P. G. does not take up water from the air. The same statement is true of T. P. G. He states that D. P. G. is a powder, and therefore agreeable to the rubber compounder. So is T. P. G. a finely divided powder. He also states that D. P. G. is a definite substance, having a definite melting point and is therefore easy to identify and check its purity. The same statement is true of triphenylguanidine. Dr. Whitby then stated that diphenylguanidine does not discolor rubber, and is therefore a good accelerator for producing white stocks. The same statement is true of T. P. G. He also said, or at least implied, that diphenylguanidine has less tendency to cause scorching of the mixing rolls and in other factory operations than the other accelerators which were known prior to 1919. This is exactly contrary to the facts. Diphenylguanidine has distinctly greater tendency to cause scorching than T. P. G., hexamethylenetetramine or paranitrosodimethylanilin,—to mention a few of the most widely used accelerators at that time. Dr. Whitby also stated that D. P. G. increased the strength, elasticity and texture of vulcanized rubber. He defines "strength" as stiffnes or toughness, and adds that this improvement in these properties will result in a rubber with better wearing qualities and resistance to operation as applied to a tire tread. Now, this is undoubtedly true as applied to a compound containing diphenylguanidine compared with compounds containing no accelerator at all. The statement as worded in his testimony, however, might have the effect, or might be taken to mean that diphenylguanidine gives better wearing rubber, stronger and more elastic rubber, than can be produced with other accelerators which

were known at that time, that is, in 1919. That is not true. For instance, T. P. G. when properly used, produces rubber of equally as high strength, elasticity and general wearing qualities as D. P. G., provided they are used in equivalent amounts. The fact that large quantities of T. P. G. are still used in the highest grades of rubber products is the most impressive confirmation of that fact. According to the figures of the United States Tariff Commission, there were 428,000 pounds of T. P. G. used in this country last year. The consumption this year will be at least 100,000 pounds greater. One large rubber manufacturer, with whose compounding practice I happen to be familiar, could save $15,000 per month by substituting diphenylguanidine for triphenylguanidine, which is now being used. He has, however, not made this change, because the shorter period of cure which is characteristic of diphenylguanidine stocks would be disadvantageous in the particular product for which he is using this accelerator. Another reason for not making the change, in spite of the possible saving, is that—as I just mentioned—diphenylguanidine has a greater tendency to cause scorching than triphenylguanidine has. There is no advantage for this manufacturer in making such a change, because his product already enjoys an unexcelled reputation in the trade.

Dr. Whitby did not state that the use of diphenylguanidine diminishes the tendency of rubber to deteriorate with age, but he did state that the patent claims that. To avoid any misunderstanding, I should like to say that it is well recognized that T. P. G., for instance, is fully equal to D. P. G. in that re-

spect. Now, there is one property of D. P. G. in which it is superior to T. P. G., or in fact any other accelerator which was known in 1919. I refer to its accelerating activity. Being a much more active accelerator, it can be used in smaller amounts to produce the same accelerating effect, and since there is but little difference in the cost per pound it is far cheaper to use diphenylguanidine. It is also generally true that the more active accelerators will effect vulcanization in the presence of smaller amounts of sulphur than the less active ones. These advantages which arise out of the greater activity of diphenylguanidine are the only advantages which diphenylguandine has over triphenylguanidine. I refer to triphenylguanidine throughout this discussion, since it is the most closely related to diphenylguanidine of the accelerators which were known prior to 1919.

By Mr. Edmonds:

34. Q. Are you familiar with the uses of diphenylguanidine and triphenylguanidine in the manufacture of hard rubber; and if so, state what the action of the two is in that particular.

A. In the manufacture of hard rubber, diphenylguanidine is of course a more economical accelerator to use, on account of its greater activity. As far as the finished product is concerned, there is no difference at all.

By Mr. Edmonds:

I wish to state on the record that the witness has here rubber slabs made in the course of all of these tests that he has referred to in his testimony, and covered by the test sheets that

have been offered in evidence. I am perfectly willing to offer these in evidence, if my adversary wishes to have it done, but I don't believe it will serve any purpose; but I merely state they are here for examination, if anyone wants to examine them.

The witness also has here samples of these disubstituted guanidines that he referred to, and they are available for inspection.

35. Q. I would like to ask you one further question. Does this chart (indicating) give the chemical formula for these disubstituted guanidines that you referred to—the six disubstituted guanidines that are not accelerators?

A. It does, and it also gives the formula for diphenylguanidine and for guanidine itself.

By Mr. Edmonds:

I offer this chart in evidence, as it may be of some assistance to us, as Defendant's Exhibit "NN".

By Mr. Wooster:

Same objections to the chart as to the examination in relation to the alleged disubstituted guanidines not involved here, and the same motion to strike out.

Objection overruled.

Exception noted to Plaintiff.

CROSS-EXAMINATION.

By Mr. Wooster:

X36. Q. You referred to the diaminoguanidine, and stated that you did not have the free base. Did you try to make it?

A. We produced the free base, but it decomposes within—I don't remember the exact time, but within half an hour or something like that, so that immediately upon producing it it must be stabilized by converting it to the bicarbonate salt, which is the best available means to prevent decomposition.

By Mr. Wooster:

I object to that answer as irresponsive and volunteered, as I did not ask anything about stabilization, and move to strike it out.

Motion allowed.

(Question read.)

A. Yes.

X37. Q. You couldn't do it, could you?

A. We did make it.

X38. Q. How do you know you made it?

A. We feel quite certain that we made it, because the process which we used could not have resulted in anything else than that.

X39. Q. Did you make the carbon, hydrogen and nitrogen determinations of it?

A. No.

X40. Q. Did you take the molecular weight of it?

A. No.

X41. Q. Did you take the melting point?

A. No.

X42. Q. Did you weigh it?

A. No.

X43. Q. Specific gravity?

A. No.

X44. Q. What did you do to satisfy yourself that you had it?

A. Nothing.

X45. Q. Are you aware of any references in the literature that say that diaminoguanidine base is unstable and cannot be isolated?

A. I am not certain of the last three words you used, but I do recall references to the fact that it is unstable, and those words may also have been used.

X46. Q. What reference do you recall?

A. I don't know that I can remember. It was some time ago that we made this material. You probably have the same one. We looked it up in the standard reference books.

X47. Q. Is Thorpe's Dictionary, 1912 Edition, a standard reference work?

A. It is considered by some to be. I wouldn't use it for Organic Chemistry myself.

X48. Q. Do you agree with this statement, taken from page 11, of that book, under "Diaminoguanidine," after the formula, "does not exist in the free state."

A. I am afraid I cannot either agree or disagree with that, the point being it certainly must exist a long enough time to permit of its identification.

X49. Q. Then you disagree with that statement?

A. Yes, I do.

X50. Q. Is it not necessary, in definitely identifying organic chemicals or compounds of the nature

of accelerators we are here dealing with, that very careful determinations of hydrogen, nitrogen and carbon content be made?

A. Not those determinations—certainly not carbon. Hydrogen and nitrogen are often determined, and of course melting points and boiling points, and so on.

X51. Q. As a fact, did you not guess that you had diaminoguanidine?

A. No, not at all, because we did make accurate determinations upon the bicarbonated salt, and they indicated that the material which we had before adding the bicarbonate must have been diaminoguanidine.

X52. Q. Will you state the process by which you did this?

A. Made the material?

X53. Q. Yes.

A. By the addition of cyanogen chloride to hydrazine, and precipitated it.

X54. Q. Then what did you do?

A. Then we got a substance which we judged to be diaminoguanidine, which we found was unstable, and so we made another preparation, and as soon as the first reaction was completed, added the bicarbonate, which produced the bicarbonate salt, which we dried and tested. It required no purification, since there are no by-products, except water.

X55. Q. So that according to your own experiments, you did not obtain diaminoguanidine base in the free state, did you?

A. I believe that we did, yes.

X56. Q. Did you obtain it so that you could do anything with it?

A. No, we did not, because it is unstable.

X57. Q. You couldn't make a cure in rubber with it, could you?

A. No, I don't think we could. We didn't try, as a matter of fact.

X58. Q. Did you make an effort to?

A. No. As a matter of fact, we found reference in the literature to its instability before we got very far, and realized it was not to be used in a rubber that way.

X59. Q. Your diaminoguanidine carbonate is an acid salt, or base, or whatever its parent is, is it not?

A. That is a pretty fine point in chemical nomenclature. You might say that sodium bicarbonate is an acid salt, and still you know as well as I do that sodium bicarbonate is a strong alkali. The same holds true with this. Bicarbonate salts are technically, according to one system of nomenclature, acid salts, but unless they are made with an exceedingly weak base, they usually have a basic reaction.

X60. Q. And bicarbonates generally are relatively easily decomposed, are they not?

A. Yes, that is right. They are easily decomposed.

X61. Q. So that as a general proposition, a bicarbonate derivative of diaminoguanidine would not be expected to be such, if any, more stable than the diaminoguanidine base, would it?

A. No, I think you misunderstand me when I say that bicarbonates are easily decomposed. I mean, they decompose at slightly elevated temperatures. Take sodium bicarbonate, for instance, you can keep it in a bottle for a hundred years, I suppose, but

you heat it up to the temperature of boiling water and it will give off carbon dioxide.

X62. Q. Did you get a decomposing temperature of your diamino bicarbonate?

A. Yes, we did.

X63. Q. What was it?

A. I don't recall what it was.

X64. Q. About what?

A. Oh, I really wouldn't be able to make a guess. As a matter of fact, I didn't make that experiment myself; one of my assistants did. I remember discussing it with him. He was interested in it from a scientific point of view rather than anything else. I didn't feel that it had anything to do with this subject here.

By Mr. Wooster:

In view of the witness's last statement, that he did not make the diamino bicarbonate, his entire testimony in relation to it is further objected to, as secondary.

By the Court:

That is a mis-statement of his testimony, as I heard it. He simply stated, as I understand his testimony, that one phase of this, this test as to the decomposing point, the melting point, was made by his assistant. I may have misapprehended his testimony.

By the Witness:

You are right, Your Honor. I might add, however, that I was assisted in all of this preparation by one of our chemists. It occupied several days. I was not in the laboratory the

entire time. He and I prepared it together. He did most of the manual labor.

By Mr. Wooster:

X65. Q. What did you have to do with the preparation of this substance—you yourself?

A. We discussed how to prepare it, ordered the raw material from which to prepare it, and I saw the operation at several stages of completion, and saw the finished product—saw the product tested in rubber myself.

X66. Q. You mean the bicarbonate?

A. Yes, the bicarbonate; that is the finished product.

X67. Q. Did you personally make any of the tests of the product?

A. No, I did not. I watched one of our laboratory assistants while he was making it himself.

X68. Q. Where you said that bicarbonate react alkalis, or bases, you meant in water solution, did you not?

A. Yes, that was what I had reference to.

X69. Q. Does that apply to solution of accelerators in rubber, you having mentioned some that dissolved in rubber?

A. No, I would be unable to say that any compound acted either as an acid or as a base in rubber. Usually, when we speak of acidity or basicity we refer to the production of—We are getting into technicalities now, but I don't see how I can answer your question otherwise—refer to the production of hydrogen or hydroxyl ions by reaction with water, and the degree of basicity or acidity is measured by the con-

centration of those ions. Now that, whether speaking of basicity or acidity, is largely theoretical.

X70. Q. Now, in your experiments in accelerators, have you tested bicarbonate or other acid salts of organic bases as accelerators?

A. Yes. I have tested the bicarbonate of diphenylguanidine and found it to have substantially the same strength, on a molecular basis, as diphenylguanidine.

X71. Q. What other ones did you test?

A. That is the only one I recall at the moment.

X72. Q. It is not common practice, or commercial practice, in this art to use acid or carbonate derivatives of organic bases as accelerators, is it?

A. Now, let us separate that question into its parts. You say, is it common practice to use carbonated derivatives of organic bases? I believe that one firm placed on the market a carbonate—or bicarbonate, I don't know which—of diphenylguanidine. It has never been widely sold, because there is no demand for it. Diphenylguanidine is stable without resorting to that. Now, is that all your question?

X73. Q. Is not the base more useful than bicarbonate derivative of the base—say, diphenylguanidine, for example?

A. As I recall it, molecular equivalent amounts —that is, containing the same amount of diphenylguanidine—of diphenylguanidine bicarbonate and of the pure base—have equal accelerating effect. Does that answer your question?

X74. Q. In that case, you must regard the addition of bicarbonate as inert, do you not?

A. Yes.

X75. Q. That is not the fact with diaminoguanidine, is it—which you cannot obtain without bicarbonate or some other combination?

A. Why, I have no reason for assuming to the contrary. Of course, there is no way of determining that, because, as I said, diaminoguanidine free base is unstable, so no one could ever make the comparison.

X76. Q. You mentioned a reference in Twiss to aminoguanidine?

A. Yes.

X77. Q. By that did you mean monoaminoguandine?

A. Yes, sir.

X78. Q. What do you know about that substance?

A. I have never tested it. As I recall it, Twiss states that it is unstable, but is a good accelerator when used in the form of its bicarbonate salt. He is a very experienced investigator, and I have no reason to doubt what he says.

By Mr. Wooster:

I will offer that for identification—the page from Thorpe's Dictionary, it to be marked as Plaintiff's Exhibit No. 12.

X79. Q. Now, referring to these tests made by you, how did you come to make them?

A. Which tests do you refer to?

X80. Q. Each of those you brought in.

A. These tests which I made on the shoddy formulas recorded in the X-book were made at Mr. Edmonds' request.

X81. Q. When?

A. I can't tell you just when he made the request.

X82. Q. I mean, when were the tests made?

A. The tests were made on the 17th of September, 1925.

X83. Q. For the purpose of this case?

A. Yes.

X84. Q. From whom did you get instructions or authority?

A. My superior officer, Mr. J. Warren Kinsman, instructed me to give Mr. Edmonds any assistance I could in the matter of making tests, and so forth, in connection with this case.

X85. Q. To whom did you report?

A. You mean, to whom did I report the results of these tests?—To Mr. Edmonds directly.

X86. Q. Do the same answers apply to the tests you made with diamino bicarbonate?

A. Yes, the same answer.

X87. Q. Exhibit "EE". And also does the same answer apply to Exhibit "HH"?

A. Yes, that answer will apply to all of these tests.

X88. Q. Referring to the chart, Exhibit "NN", how did you make the dibenzoylguanidine, which is the one in the upper right corner?

A. I believe I stated that I only tested those compounds. They were made by Dr. Harold Powers, of the Dupont Company.

X89. Q. Oh, you took his say-so that it was dibenzoylguanidine?

A. That is right.

By the Court:

X90. Q. You say you tested this yourself—you mean after—

A. I tested it in rubber, Your Honor.

X91. Q. You assumed the stuff to be what another man told you it was?

A. As a matter of fact, at the same time he gave me melting points, melting points taken from the literature, to compare them with, and in one or two cases nitrogen determinations,—that is, he reported to me the actual results of such tests he had made, to check up on the purity and identify of these compounds. But I did not make any of these tests or witness the making of any of these tests which established the identity. I merely saw the results of the material, and I am in the habit of taking Dr. Powers' word on such matters as that.

By Mr. Wooster:

I move to strike the entire exhibit out, as wholly incompetent, in view of what this witness says—also the testimony with relation to it, particularly these charts of Exhibit "HH".

X92. Q. Who is this man who furnished you with the substance?

A. He is an organic chemist who has worked with me, is working with me, his part being the preparation of organic compounds and my part being the testing of them in rubber.

X93. Q. Is he your subordinate?

A. A subordinate.

X94. Q. Did he do this at your direction?

A. At my request, yes—my direction. I did not, however, tell him the exact procedure to use in

these preparations. He is, for that matter, more competent to decide such things as that than I myself, since his specialty is organic chemistry, and mine is rubber chemistry.

By Mr. Edmonds:

If the Court please, this man works in an organization, and with him is a man who in this particular branch of the work, the preparation of these organic chemicals, is recognized by Mr. Bridgwater and everyone else as having more skill and being more competent than he is himself—

By Mr. Wooster:

We do not.

By Mr. Edmonds:

So he himself would, from the standpoint of accuracy, rather have this other man make these chemicals than make them himself.

By the Court:

Presuming that to be so,—in order to give them a foundation here for evidence, we cannot take all those things into consideration. That is, the witness's idea of the matter.

By Mr. Edmonds:

That is perfectly true, and therefore, if this matter is pressed, it is going to be necessary to take this man out of the laboratory and bring him down here and have him say that he made these substances,—a thing that can be done, but it is a very unnecessary thing to do, when we know in advance he is going to say just exactly

what the man who is working beside him, and who is familiar with all of his work, says he did.

By the Court:

That is yet another question. In the face of objection.—

By Mr. Edmonds:

If the matter is pressed, that is what I shall do,—bring this man down here on the night train and have him here tomorrow morning. But I think that counsel ought not to make every individual thing of that sort necessary.

By the Court:

Well, of course, that is up to counsel.

By Mr. Wooster:

Well, you insisted on putting these in over our objection that they are not an issue in the case and not up for consideration.

By Mr. Edmonds:

Suppose we bring this man here, and he says he made them, it would be perfectly competent to say, "Where did you get the glass of water that you used in this?" and if he happened to say, "I got it from so-and-so, distilled water," it is competent to ask him, "How do you know that was distilled water?" and then we would have to bring another man in here to testify to that.

By the Court:

Of course, the weight of that is another question, but it seems each main subject ought to be taken, and in the face of objection, I am afraid

I must sustain the objection, unless there is an offer to follow by proof. I am free to say that I question the importance, because I think the case will be decided on more general lines, as I grasp it at the present time.

By Mr. Edmonds:

Well, I make the offer to produce this individual, but before sending for him. I shall make another effort to prevail on Mr. Wooster not to make it necessary. I don't think he should, but if he does, then I shall produce him.

By the Court:

In view of that offer to follow with testimony in regard to the chemical furnished the witness by his assistant, we will overrule the motion and note an exception to the plaintiff.

By Mr. Wooster:

X95. Q. Have you ever had any experience in distinguishing guanidines and ureas from each other?

A. I don't quite get the import of your question. I know the difference between a urea and a guanidine, of course.

X96. Q. I mean, have you ever examined a substance to determine whether it was a guanidine or a urea?

A. No, I don't recall that I have ever made a test myself.

X97. Q. In at least some instances, would it not be necessary to make carbon, nitrogen and hydrogen determinations?

A. Oh, I don't think so. The melting points

recorded in the literature—if it was a compound that was recorded of course—

X98. Q. But do you not find melting points of some guanidines very close to ureas of similar chemical structure?

A. Yes, that is right. I suppose you do.

X99. Q. So that the melting point is not a true criterion of the constitution of a compound, is it?

A. No, it is not, where the melting points of other compounds which might be there come close In that case you must resort to nitrogen determinations—about the most accurate elemental determinations you can make, and therefore are very commonly used. A nitrogen determination would be by far the best way to differentiate between a urea and a guanidine, because there is so great a difference in the percentage of nitrogen.

X100. Q. So that in some cases, to differentiate between a urea and a guanidine, you would have to take a nitrogen determination, would you not?

A. Yes, I think you would, in some cases. It depends upon how the melting points come.

X101. Q. Referring to your chart Exhibit "NN", you said one of the substances listed was an arylsubstitutedmonoguanidine?

A. Yes, this is (indicating on chart).

X102. Q. The one marked "disulfophenylguanidine"?

A. Yes.

X103. Q. Why do you say that?

A. Because the hydrogen—or rather, two of the hydrogens are replaced by carbon to an aromatic

ring. "Aryl" means a substitute,—substituted with an aromatic ring—that is where the word comes from. An aromatic ring is a six-membered carbon ring, with or without other constitutents.

X104. Q. You regard the sulphophenyl group as an aryl group?

A. Certainly.

X105. Q. What is the nature of sulfophenyl relatively to phenyl in basicity?

A. The group in general—of course, when we talk about basicity we have to get it into compounds where we can measure basicity—the group in general has more acidic properties.

X106. Q. That is characteristic of groups such as SO_3, OH, NO_2, and others, is it not?

A. No. It is characteristic of SO_3 and NO_2. Of OH I wouldn't want to say that. Take, for example—well, let us take methyl alcohol, that has an OH group, the hydrocarbon constituent, or ethyl alcohol, we don't call those acidic.

X107. Q. I notice in several of your compounds on this exhibit "NN" you have introduced oxygen.

A. That is right, sir.

X108. Q. Did you find any oxygen in diphenylguanidine?

A. No, sir.

X109. Q. Do you think a substitution of oxygen makes any difference in the action?

A. No, I don't think so. A good example of that is dianisylguanidine, which has oxygen in it, and is a more powerful accelerator than diphenylguanidine.

X110. Q. Where is that one mentioned?

A. Well, that is not on that list.

By Mr. Wooster:

I object to that answer, as irresponsive and volunteered, and move to strike it out.

A. Will you repeat the question?

By Mr. Wooster:

He brings in another one now that I have not asked him for. I asked him about this chart.

By the Court:

But the thing is this: A witness on cross-examination is always entitled, of course, to an explanation of his answer, and we cannot be striking out all this matter which the witness may use, which is more or less collateral to the main issue. Here he just simply gives his reason for his answer.

X111. Q. In your direct testimony regarding the X-book, pages 2005-H, 2006-H, 2006-B, and blank column of 2006, did you give the various cures and times of cures?

A. I don't know that I read them off. They are all shown in the book here, and the cures that I used are exactly the same as what are shown in the book.

X112. Q. You mean the cures that you used in stating your conclusions?

A. And also the cures that I used in the reproduction of these formulas.

X113. Q. I did not ask you about reproductions.

A. No, I did not state the cures Do you want me to?

X114. Q. Not if they appear there. I am asking you if you considered the cures?

A. Yes, indeed, I did consider them.

X115. Q. And the various times and temperatures, in giving your conclusions?

A. Certainly.

X116. Q. Did you mean to be understood as testifying that those tests you considered show that triphenylguanidine is better than diphenylguanidine as to activity and increase in tensile strength and other physical qualities of the rubber as given in these tests?

A. Yes. I believe that as far as these tests go, they do show that. I do not, however, wish to be misunderstood. A man might, by conducting more tests following these, varying the time of cure and other factors, have found out that diphenylguanidine was in fact a better accelerator for this stock than triphenylguanidine, but it does not appear here.

X117. Q. In your direct testimony did you give consideration to stretch and set, in forming your conclusions?

A. No, I did not mention those factors, because as I went over them, the differences were small and within experimental error, and they did not prove anything, and I therefore drew my conclusions largely from the tensile, and in order to make my point more clear, I did not encumber my statement with a number of figures that had little or no bearing.

X118. Q. What you have said is tensile are the notations in the column opposite "Strength"?

A. Yes. When I say "tensile" I mean tensile strength; those words are synonymous.

X119. Q. That you took to be the tensile strength at which it breaks?

A. Obviously that is what it means here.

X120. Q. In giving your direct testimony, did you consider the test on shoddies H-2005, lefthand page, column H?

A. Yes, I did; I compared that with X-2006, column H.

X121. Q. Did you re-test both of those?

A. No, I did not, although I tested practically the same thing—

By Mr. Wooster:

I object to that.

By the Court:

Just answer the question. If it is necessary, counsel on the other side can bring that out. But answer the question.

X122. Q. Which one did you not test yourself?

A. I tested 2006, column H, and then tested X-2005, column H, excepting that I used 18 of barytes instead of 20.

X123. Q. But the direction here is to use 20 of barytes.

A. At the time I made the test I had not seen this column here. My whole point was to test this X-2006-H, with and without diphenylguanidine.

X124. Q. But you must have made some other change, because X-2005-H and X-2006-H both add up to 100.

A. I think you will find that one of my formulas adds to 98.

X125. Q. But we have no formula in the X-book adding to 98, have we?

A. No.

X126. Q. Then why should you make one adding to 98?

A. Because I wanted to find out what effect, if any, diphenylguanidine had in X-2006, column H.

X127. Q. Several times here in your testimony you have referred to experimental error. What do you mean by that?

A. Oh, the unavoidable errors in mixing and curing and testing.

X128. Q. Difference in quality or characteristics of materials?

A. Yes; although that would not apply on any of these tests, because they were all made with the same raw materials.

X129. Q. Doesn't the milling of the rubber make a difference in the tensile strength you get from the cure?

A. Yes, indeed, it does.

X130. Q. Did you mill your rubber in these tests you made?

A. Yes.

X131. Q. Did you break it down yourself?

A. Yes, I broke it down myself, and it was previously broken down on a large mill also.

X132. Q. I mean, did you do all the breaking down?

A. I did not do the preliminary breaking down, no.

X133. Q. You got broken-down rubber into your place and then went on with it?

A. Then went on and gave it a further breaking down, which is our usual custom.

X134. Q. Where had that rubber been originally broken down?

A. It was broken down in the plant of the Lee Tire and Rubber Company, I believe.

X135. Q. Was it done under your supervision?

A. Oh, no, not at all.

X136. Q. Doesn't it make a considerable difference in the result in a test as to how that original breaking down is conducted?

A. Why, it makes a difference in the tensile strength, if there is any substantial percentage of rubber there at all. Of course, these shoddy compounds, one of them contains no rubber and the other one only contains five per cent, and the same rubber was used in all three of these check tests.

X137. Q. I mean, if you want to get a high tensile, can you not juggle the breaking down and milling of the rubber, so as to increase the tensile; and if you want to get a low tensile, can you not juggle the breaking down and milling of the rubber so as to make the tensile come out low?

A. Yes, you can get some differences that way. High tensiles usually result from not breaking down the rubber at all, and low tensile from giving it a double or excessive breaking down.

X138. Q. So isn't it fair to say that a test made by you today in the Dupont laboratories with materials such as you used, and with rubber milled by the Lee Company, is not strictly comparable with tests such as are reported by Mr. Weiss in that X-book,

made years ago, under different conditions and with different materials?

A. You are right. Of course, all of these tests were made with the same rubber, and as a matter of fact, the results which I got in duplicating his formulas gave almost exactly the same tensile. It had not before come to my attention that 2005, column H, was almost exactly the same formula as my Ed 1-A, and now that I notice it, I find a difference of less than 50 pounds in the tensile strength, which is a remarkably good check; in other words, I am led to believe that from that and the way those other results check, the conditions of my test must have been very close to the conditions of his.

X139. Q. In your direct testimony where you were comparing D. P. G. and T. P. G. you inserted a proviso in one answer, where these substances were to be used in what you said "equivalent amounts." Will you explain what you mean by "equivalent amounts"?

A. Yes. I used "equivalent amounts" in the sense of amounts which will produce the same degree of acceleration. In other words, equivalent amounts were what Dr. Kratz gave us in his paper.

Mr. Wooster:

I object to that, as volunteered and irresponsive.

By the Witness:

That is the best answer I can make.

By the Court:

You asked for an explanation, and he explains it in his own way. Whether that is sufficient or not is another question. As a matter of fact, I thought he explained it very well—at least I thought I understood it, when he passed over it.

X140. Q. You mean "equivalent amounts" amounts that would obtain the same tensile strength in a given sample of rubber—given compound of rubber?

A. Amounts which would obtain or produce the same rate of cure. As a matter of fact, when you do use amounts which produce the same rate of cure as between those two accelerators, there is substantially no difference in the tensile strength. The equivalent amounts as defined from the rate of time of cure, not by reference to the tensile strength.

X141. Q. Then would another way be to state it, that you use such amounts that in the same time, on the same compound, and with the same temperature, you get the same tensile strength?

A. No, that wouldn't be an exact statement, because, you see, the selection of equivalent amounts is based wholly upon an attempt to make these two compounds, one containing one accelerator and the other the other, cure in the same time. Now, if they happen to have the same tensile strength after you accomplish that result, that is incidental, it is not primary.

X142. Q. Then do you mean by "equivalent amounts" the amounts which make the same compound cure in the same time?

A. At the same temperature, yes.

X143. Q. Now, how do you determine the cure?

A. The cure is determined in practice by a large number of tests, which are quite technical, and I don't know whether you want me to go into them here. The shape of the stress-strain curve, the shape and position of the tensile curve, and the resistance to tear, such matters as that are what determine the period of cure; and sometimes the combined sulphur is also used, and the modulus of low elongations.

X144. Q. Well, is that the best answer you can give as to what you mean by "same cure"?

A. Yes, that is. As a matter of fact, you won't find any two rubber chemists who agree exactly as to what are equivalent cures; in other words, I might say that this compound cures in 38 minutes, another fellow come along here and say he thinks this compound is best when it is cured for 42 minutes, and I don't know who is right,—because we have so many criteria, and so many standards of judgment. But they all run pretty close together. Within reasonable limits, we all agree on equivalent cures.

X145. Q. Now, as I understand you, you take a given compound and cure it with, say, three-fourths of one per cent of diphenylguanidine for what you call the optimum cure, and you get a certain tensile, and aging qualities, and set, and stretch, and strength at a fraction of the total elongation, and all that. Now, is it your opinion that by taking a different quantity of triphenylguanidine, with a different time of cure, you can get exactly the same result?

A. No, I wouldn't say that you would get the same result in each of those particulars. For instance,

the triphenylguanidine, when it is correctly cured, will have a higher elongation. That is just a characteristic of triphenylguanidine.

CLIFFORD W. SANDERSON, a witness produced on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Edmonds:

1. Q. Mr. Sanderson, will you state your residence and occupation?

A. Long Meadow, Mass.; chief chemist of the Fisk Rubber Company.

2. Q. And you have held that position how long?

A. Since 1916.

3. Q. And prior to that, what was your occupation?

A. I went there directly from college.

4. Q. You took a technical course and got your degree at college?

A. Regular course in chemistry, with a degree of bachelor of science.

5. Q. Please look at Tables 1 and 2 of Exhibit "E", Kratz paper, and state whether or not they express the relative accelerating value of the substances named, and if so, how those values are expressed.

A. They do express the relative activity of the accelerators given in the table, and this relative activity is expressed in the amount of accelerator required in a given formula to effect vulcanization to an equivalent extent.

6. Q. By the way, did you attend the meeting where this paper was read?

A. I did.

7. Q. You heard Kratz read the paper?

A. I did.

8. Q. May relatively accelerating values be expressed otherwise, and if so, how?

A. Yes. There are several ways by which relative activity of accelerators may be expressed. Kratz used one way, namely, showing the different amounts of accelerator necessary to effect an equivalent cure. The other common way is to take the same amount of accelerator and show the difference in time necessary. Another way to show the relative activity of two accelerators would be to say that one will cure at a lower temperature; and the third, or fourth way would be to say that one would require less sulphur. The last two are not as common, and not as good methods, because there are other complications there.

9. Q. Then will you state in what ways the superior accelerating value of an accelerator may be utilized?

A. The greater accelerating value of an accelerator may be used either to cut down the time, if the same amount is used, or, providing the price is about the same, to save money by using less and curing for the same length of time.

10. Q. Is it common in commercial practice to avail oneself of the superior accelerating value of accelerators to cut down the amount used?

A. In commercial practice it is done both ways. There are other limiting factors there. For example, in curing an ordinary article, particularly a thick

article, there is a limit to the amount you can cut down the time; and if you cut down the time as much as possible, you cut down the accelerator. The cost factor enters in there, because in some operations it would be more economical to save time than it would be to save the accelerator.

11. Q. If, instead of using a less amount of a superior accelerator, its greater activity were utilized to permit of the reducing of the time, or the temperature, or both, of the cure, what result would be achieved?

A. If the activity of the accelerator is used to cut down the time, you will get a better product. That is ordinarily considered to be due to this fact: It is quite commonly accepted that vulcanization consists of two different things going on at the same time, the rubber is being broken down or depolymerized, and is being built up or polymerized by the accelerating action, and the net result is what we know as the vulcanized product.

12. Q. Has this bettering of the product through the use of accelerators been known and recognized by workers in the rubber art for some time?

A. Yes, it has been known and recognized, and developed, practically since the beginning of the use of organic accelerators. This is shown clear back in the Hoffman and Gottlob patent, No. 1,126,469, in which they said: "We have now discovered that the vulcanization of rubber generally, either natural or synthetic, can be materially promoted by the use of a methylene base, and particularly by the use of a piperidine base," etc. "and that by the use of such a base the vulcanization process proceeds more

smoothly and more quickly, while an improved product is obtained."

This principle is also brought out by Peachey in an article in the "India Rubber Journal" for October 28, 1916, in which he says: "It appears also that goods vulcanized in the presence of the new accelerator show a somewhat greater tensile strength than those cured in the normal time. Investigations on this point have not yet been completed, but a probable explanation is that the greatly reduced time of heating in which to bring about perfect vulcanization leads to a diminished amount of depolymerization, and this results in an increase in the nerve or strength of the rubber."

King, in "Metallurgical and Chemical Engineering", September 1, 1916, also points out the beneficial effect of accelerators, and the same thing is brought out very clearly in an article by Twiss and Brazier in the "Journal of the Society of Chemical Industry" for May 15, 1920, in which they say: "Most of them" that is, referring to accelerators—"but not all, by reducing the time of heating necessary cause a production of a rubber with a higher tensile strength than would be obtained by more tardy vulcanization at the same temperature, without the catalyzer, and in this direction reduction of the time of vulcanization by using an increased percentage of sulphur can have a similar effect."

These bring out the beneficial effects from the reduction of the time of cure. Now, with a given compound, within reasonable limits, and comparing accelerators of two different degrees of activity, it is possible to get the same benefit by using more of the

weaker accelerator in order to bring the time of cure down equivalent to the smaller amount of the more active accelerator. In other words, the beneficial properties are due, at least very largely, to the reduction of the time in cure made possible by the use of the accelerator.

By Mr. Edmonds:

I offer in evidence the documents just referred to by the witness, namely: "Hoffman patent No. 1,126,469, as Defendant's Exhibit "OO".

Also, a copy of an article on "Vulcanization Accelerators", by S. J. Peachey, published in the "India Rubber Journal" for October 28, 1916, as Exhibit "PP".

Also, a copy of an article entitled "Rubber Vulcanization Accelerators", by Andrew H. King, published September 1, 1916, as Defendant's Exhibit "QQ".

Also, an article on the "Acceleration of Vulcanization", by Twiss and Brazier, in the "Journal of the Society of Chemical Industry", May 15, 1920, as Defendant's Exhibit "RR".

With reference to these publications, the publication and the distribution of them, as of the dates named, is conceded.

13. Q. Now, will you look at the Weiss patent in suit, particularly the sentence beginning at line 66 and ending at line 70, on the first page? As the statement is there made, I gather you consider it incorrect, and to state the proposition fully it should say something about the amounts of the accelerators used. Is that correct?

A. Yes. That is the way it would ordinarily be taken by anyone familiar with the way of expressing the relative activity of accelerators. It would naturally be taken at the same amounts.

14. Q. This patent suggests that with D. P. G. a better product can be produced than with T. P. G. Do you agree to that?

A. No, not without explanation of the amount used. As I explained there, by the proper amounts, and using T. P. G. under the proper conditions, you can get what you can with D. P. G.

15. Q. Well, is there any suggestion in this patent of what are the proper conditions for the use of D. P. G. whereby you can get a superior product?

A. No.

16. Q. For instance, take this formula given in the patent,—is that a formula that approximates present day commercial practice?

A. No. The sulphur is too high in there, and the amount of diphenylguanidine is higher than would be considered good practice.

17. Q. The patent seems to make some point of the production of rubber which is free from bloom. Would that formula given in the patent produce a rubber that is free from bloom?

A. It would not, if cured to the proper state.

18. Q. If you tried to make a non-blooming stock by that formula, under those directions, what would happen?

A. It would be very much overcured and would perish in the laboratory.

19. Q. The patent suggests that with diphenylguanidine a product which is better with respect to

aging qualities can be produced. Do you agree with that?

A. You can get just as good aging rubber with triphenylguanidine as you can with diphenylguanidine.

20. Q. Please note the statement in the patent about hard rubber, beginning in line 55 on the first page and running over to line 61. What is the nature of that?

A. I wouldn't say that you could get any better rubber with diphenylguanidine than you could with triphenylguanidine.

21. Q. No better hard rubber?

A. No better hard rubber.

22. Q. Will you state what the fact is with reference to the flat curing curve—or the flatness of the curing curve, with diphenylguanidine and with triphenylguanidine?

A. That, again, all depends upon the conditions of use. In the formula of the patent, you would not get a very flat curing curve with diphenylguanidine, in fact, you would probably get a better or flatter curve with T. P. G., under the conditions conforming to the patent.

23. Q. Well, are there other conditions not pointed out in the patent whereby you might secure a flatter curing curve than with these conditions that are named?

A. I am not positive about that. That would depend somewhat upon how high a temperature you used. I would say that at fairly low temperatures you could get a flatter curve with T. P. G. than with D. P. G.

24. Q. How does the practice put forward in this patent in suit, in the formula that is stated there, compare with the commercial practice, in the use of hexamethylenetetramine and triphenylguanidine?

A. The amount of accelerator is more nearly right for T. P. G. than hexa.; the amount of sulphur is somewhere near commercial practice for T. P. G. and too high for hexa.

25. Q. Have you made a comparison of results that would be obtained, following the formula of the patent in suit, and using D. P. G. as suggested there, and a similar mix wherein T. P. G. is employed?

A. I have.

26. Q. Will you state with what result?

By Mr. Kennedy:

Anticipating that this may refer to tests made for the purpose of the suit, I renew my objection previously stated. And I assume that objection may run, without repetition.

By the Court:

Let the record show the objection, and that it may be a running objection.

A. I have taken here and duplicated the formula of the patent namely: Rubber 50; zinc oxide 45½; sulphur 3½; D. P. G. 1, and I have cured that over a range of cures from 10 minutes to 50 minutes at 40 pounds, and gotten the tensile strength and elongation. And I have also taken a formula which is exactly the same, except that for one part of D. P. G. I substituted eight part of T. P. G., which is just about the ratio shown by Kratz, and similarly, I have

cured it over the same range of cure, and made the same test. These results show that the maximum tensile obtainable with D. P. G. and with T. P. G. differ only by one point—that is just an accidental difference, because the method is certainly not accurate, anywhere near that extent. In other words, I obtained the same tensile with the T. P. G. formula as with the D. P. G. The tests bore out what I said before, because the rate of cure, as shown by the test results over a range was about the same. As far as flatness of cure goes, the D. P. G. results start at 2390 and go up to 3480, and after 50 minutes had dropped down again to 2460, while the T. P. G. starts 2245, or practically the same, and goes up to a maximum 3479, or practically the same as the maximum of the D. P. G., but at the end of 50 minutes is still up to 3350 pounds.

The elongations for the corresponding loads are slightly greater for the T. P. G. sets than for the D. P. G.

By Mr. Edmonds:

This sheet regarding the witness's test is offered in evidence as Defendant's Exhibit "SS."

By the Witness:

I also have the slabs of rubber cured over the same range, which show that, if anything, the T. P. G. set feels a little snappier than the D. P. G.

By Mr. Edmonds:

I will offer in evidence this set of rubber slabs just produced by the witness as Defendant's Exhibit "TT."

27. Q. Is there any further explanation of what these slabs represent?

A. They represent exactly what is shown on the sheet; in other words, the two formulas, as represented, cured over the same range of cure.

28. Q. Isn't it a fact there are two groups of slabs here, each group representing a series of tests wherein some one factor varied progressively?

A. We have two sets, the same as we have two formulas.

29. Q. Will you look at the Weiss patent, particularly the sentence on page 2, beginning at line 15, and state what your views are on that point?

A. Why, that is practically meaningless, because that had been done years before. It was even done before organic accelerators had been discovered. For example, in a tire it is necessary to have parts that are harder and less elastic.

30. Q. Is that a common practice with hexa. and other accelerators?

A. Yes; it is. I say it was done even before organic accelerators were discovered.

31. Q. And with those accelerators, was it accomplished in the same way?

A. Yes.

CROSS-EXAMINATION.

By Mr. Wooster:

X32. Q. On this Exhibit "SS," who is E. W. Fuller, whose name is signed there?

A. The man who actually did the work.

X33. Q. You did not do the work yourself?

A. I did not do the actual testing myself.

X34. Q. These are figures given to you by him?

A. That is right.

X35. Q. Where were you when he was doing the work?

A. I was present part of the time; part of the time I wasn't. It was done under my direction, but I wasn't present at all times.

X36. Q. Which of these readings given here did you see taken?

A. I can't identify them.

X37. Q. Did you do the weighing?

A. No, sir.

X38. Q. Did you do the timing?

A. No, sir.

X39. Q. Read the steam gauge for the temperature?

A. No, sir.

X40. Q. Look at the machine that gave the tensiles and elongation?

A. I watched it—I was present and watched it.

X41. Q. What was it—a Scott machine?

A. No; an Olsen.

X42. Q. Do you take readings off that machine, or does it draw a curve?

A. It draws a curve.

X43. Q. Then you translate the curve?

A. Mr. Fuller did that.

X44. Q. Mr. Fuller translated the curves? What became of the test pieces, that went into the machine?

A. I can't say whether Mr. Fuller save those or not.

By Mr. Wooster:

In view of the answers of this witness, I move to strike out the testimony and this exhibit, as secondary and not proven.

By Mr. Edmonds:

If your Honor please, Mr. Fuller is present, and will be placed on the stand next. It had not occurred to me that any such objection as this would be offered, or I certainly would have put Mr. Fuller on the stand first.

By the Court:

Very well. We will overrule the objection and note you an exception, in view of the offer of further proof.

X45. Q. I understood you to say that the formula of the patent in suit would be very much overcured. Did you mean with the cure given in the patent, or if you continued the cure with that high percentage of D P. G.?

A. The question was: if you cured that formula to a non-blooming state, and I answered that it would be overcured.

X46. Q. What was the time required to bring it to the non-blooming stated—and temperature?

A. Why, I think it would take about two hours.

X47. Q. What temperature?

A. At 40 pounds.

X48. Q. Wasn't this the result that you thus obtained?

A. Not on that actual formula. I was simply speaking from experience.

X49. Q. Oh, you were speaking from your general experience, not from any specific tests, when you said that that formula of the patent would be very much overcured, if you cured it until there wasn't any bloom?

A. I know that for a fact, that you can't cure rubber with a large per cent. of sulphur on the rubber to a non-blooming state and not have it overcured.

X50. Q. Well, at the time rubber is non-blooming practically all the sulphur is combined, is it not, or do you have non-blooming stocks with considable percentage of free sulphur?

A. It depends upon the amount of rubber present in the compound. If it is nearly a pure gum compound, you can have 75/100 of a per cent. of sulphur left and still have it non-blooming. With that amount of rubber there, there would have to be less than half a per cent. of free sulphur, I would say.

X51. Q. In order to have it not to bloom. Did you write any report to your company on what you heard at that Philadelphia meeting in 1919?

A. I was in the habit of taking notes. Whether or not I did take notes or not there, I can't say.

X52. Q. You haven't the notes now, have you?

A. No, sir.

X53. Q. Would you say you did not make any formal report to your company of what happened at that meeting?

A. I can say that I made no formal report to the company; yes.

X54. Q. Does your company use diphenylguanidine in its standard formulas?

A. Not at the present time.—I won't be certain of that. We may use some small amount in some compound. It is not one of our large accelerators.

X55. Q. Your company principally uses methyleneparatoluidine?

A. We have in the past.

X56. Q. And you have a patent covering that, have you not?

A. Yes.

X57. Q. Do you use more T. P. G. than you do D. P. G., or vice versa?

A. We are not using any T. P. G.

X58. Q. And you use some D. P. G.?

A. Whether or not, right at the present time, we are using it, I can't say. We have never used D. P. G. very extensively.

EDWARD W. FULLER, a witness produced on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. Where do you reside, please?

A. Springfield, Mass.

2 Q. And with what company are you connected?

A. Fisk Rubber Company.

3. Q. In what capacity?

A. Research chemist.

4. Q. You have been doing that right along?

A. Four years.

5. Q. I show you Defendant's Exhibit "SS," which Mr. Sanderson just testified to. State what you know about that, and what, if anything, you did?

A. I conducted this test from the weighing out of the raw material to the testing of the cured rubber.

6. Q. At the request of Mr. Sanderson?

A. At the request of Mr. Sanderson.

7. Q. Under his more or less direct supervision?

A. Yes, sir.

8. Q. And with his approval?

A. Yes, sir.

CROSS-EXAMINATION.

By Mr. Wooster:

X9. Q. Have you the test pieces with you from which you made up those tables?

A. No—the pieces were broken.

X10. Q. Those are the ones I mean.

A. The slabs I presented here were the same time and the same cure.

By Mr. Edmonds:

X11. Q. What are these slabs, Exhibit "TT"?

A. Consists of 100 parts of rubber, 91 parts of zinc oxide, 7 parts sulphur, 2 parts D. P. G., cured various lengths of time at 40 pounds of steam pressure.

By Mr. Wooster:

Witness reading from the top slab?

By the Witness:

Reading from the top slab; yes, sir.

X12. Q. Are these slabs the slabs that you produced in the course of the tests which gave you the information which is recorded on Exhibit "SS"?

A. Those were cured at the same time, and in the same mold, but the slabs were broken.

X13. Q. The first five of them were cured with D. P. G. and the second five with T. P. G.?

A. Yes, sir.

X14. Q. Changing the time of the cure in each instance, in each of the series of five?

A. Yes, sir.

X15. Q. That was done by you?

A. Yes, sir.

X16. Q. As I understand it, the results recorded on this sheet Exhibit "SS" were obtained from pieces of rubber that were cured in the mold at the same time that these pieces Exhibit "TT" were cured?

A. Yes, sir.

By Mr. Wooster:

X17. Q. Well, this Exhibit "SS" is a compilation of averages taken from a whole lot of pieces you tested, isn't it?

A. The resultant average of four individual pieces broken.

By Mr. Kennedy:

The objection as to *ex parte* tests applies here, your Honor.

X18. Q. Some of those pieces tested high and some low, did they not?

A. They varied slightly; yes, sir.

Adjourned until Thursday, October 15, 1925, at ten o'clock A. M.

Thursday, October 15, 1925.

MORNING SESSION.

By Mr. Edmonds:

If your Honor please, defendant's case is complete, except for two witnesses which we will have to produce because the other side wishes to examine them on points that I think are unnecessary.

SETH R. CLARK, recalled, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

53. Q. During the course of your work with the Republic Rubber Company, did you become closely familiar with "C" shoddy, and with "G" shoddy?

A. I did.

54. Q. At a time quite recently, did Mr. Bridgwater try to obtain from you as to what shoddies now available most closely approximate the "C" shoddy and the "G" shoddy of the Republic Rubber Company?

A. He did.

55. Q. Did you tell him?

A. I did.

56. Q. The "C" shoddy and the "G" shoddy of the old Republic Company cannot be bought now under those names, can they?

A. They cannot. They were special reclaims made there, and they are no longer available.

57. Q. You told Mr. Bridgwater what, from

your experience, you believed to be the most closely available shoddies to those two?

A. Yes.

CROSS-EXAMINATION.

By Mr. Wooster:

X58. Q. Do you know the composition of the "C" shoddy or the "D" shoddy, as made by the Republic?

A. No one knows the exact composition of any specific lot of "C" shoddy or "D" shoddy made by the Republic.

X59. Q. Meaning that you do not know?

A. No one knows the composition. Those reclaims vary considerably from lot to lot. In minor considerations, they would not affect tests.

X60. Q. Was it part of your duty at the Republic to prepare these shoddies?

A. I was very closely associated with the preparation of them; yes, sir.

X61. Q. I asked if it was in your charge to make those shoddies?

A. I did not make the reclaims.

X62. Q. Did you determine the process by which they were made?

A. That was a patented process. I did not invent the process.

DANIEL H. POWERS, a witness called on behalf of defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

1. Q. Will you please state your present occupation and place of residence?

A. At the present time, I am employed by the Du Pont Company as a research chemist, and as a research chemist dealing with the preparation of synthetic organic compounds. My residence is Pennsville, New Jersey.

2. Q. From what college did you graduate?

A. I received an A. B. degree from Boston University.

3. Q. What year was that?

A. 1921.

4. Q. Thereafter, did you pursue your studies at another college?

A. At Princeton University.

5. Q. For what period and leading to what degree?

A. In 1923 I received a Master's degree from Princeton University, and in 1924, I received a Doctor's degree from Princeton University.

6. Q. Did you do some special work in the preparation for your Doctor's degree, and if so, state what it was?

A. In the preparation to obtain my Doctor's degree, there was first of all the general examination, of course, which implied a general knowledge of chem-

istry. The special work was devoted to the preparation of some fifty new, undescribed compounds, in connection with my thesis work on a series of new compounds.

7. Q. Have you recently, at the request of Mr. Bridgwater, prepared certain organic compounds, or rather, the particular six organic compounds whose names appear on this Exhibit "HH," which I now hand you?

By Mr. Kennedy:

I assume our objection as to *ex parte* testimony shall run without repetition.

By the Court:

Yes.

A. I have.

By Mr. Edmonds:

8. Q. Was the preparation of those substances conducted with such care and such attention to detail, and in such accordance with the most approved chemical methods, that, as a result, you are able to say that the substances which you prepared are in fact the six substances whose names appear here?

A. Yes, I am.

CROSS-EXAMINATION.

By Mr. Wooster:

X9. Q. Did you analyze the raw materials you used before starting the preparation of these substances?

A. I analyzed them in every case where it was at all necessary.

X10. Q. You decided for yourself whether it was necessary, did you?

A. I feel sure that the standards that are required for that work were entirely equal to, and superior to, most analyses that are necessary for synthetic work on new hitherto undescribed chemicals.

X11. Q. But I mean, you made the decision yourself as to what purity of materials you would accept?

A. All materials that I accepted were materials whose purity are accepted wherever they are sold as accepted purity.

X12. Q. That may be so, but what I asked is: you yourself made the decision as to whether you would accept the purity of the material as you got it or test it?

A. Who shall be definitely qualified to make that opinion better than myself?

X13. Q. It is not a matter of qualification. I am asking if that is what you did. You made the decision, did you not?

A. Would you state just exactly what you mean?

X14. Q. You decided whether or not to accept the material which was handed to you, or to test it for purity?

A. Yes, on the strength of where I received the materials.

X15. Q. Did you find any of these reactions mentioned in the books?

A. Three of them.

X16. Q. And the others you worked out for yourself?

A. I did.

X17. Q. After you got the materials you were after, what tests did you subject them to?

A. I subjected them to a series of tests that would check their purity, in most cases, by four distinct methods, and I think in other cases, by at least three different methods.

X18. Q. Will you give those methods?

A. First of all, where the melting points of the compounds were known, I took that. That is usually accepted as a satisfactory criterion alone. Then I analyzed it for at least one of its constituents; that is, one of the elements that was present, and then its physical properties, such as appearance, and finally as to its solubility.

X19. Q. Is that all you did?

A. Beside that, the method of preparation in itself is a sufficient indication and a very strong consummation of construction.

X20. Q. Did you make any nitrogen determinations?

A. Where they were necessary.

X21. Q. You decided that?

A. I decided that with discretion.

X22. Q. Did you take any molecular weights?

A. I don't believe it was necessary.

X23. Q. Meaning, you did not take any molecular weights?

A. I did not.

X24. Q. Did you make any carbon or oxygen or hydrogen determinations?

A. I did not, and I feel it would be absurd to make such.

X25. Q. If you did not obtain molecular weights,

how could you be certain that you had a substance of simple formula or a polymer of greater molecular weight, but having the same percentage compositions of carbon, nitrogen, oxygen and hydrogen?

A. Its melting point would check if you would accept the work of a previous author in the literature, as a chemist does usually. That would check that it was not a polymer.

X26. Q. What did you do when you did not have the substance mentioned?

A. I studied its properties as to solubility, which in many cases vary widely when there is a change of polymer modification.

X27. Q. Is it not a fact some urea compounds are very close in melting point to guanidine compounds of quite a different nature?

A. Not along the line I was studying here.

X28. Q. Do you yourself accept melting point alone as an accurate indication of whether or not you actually have the substance which you started out to get?

A. Not alone.

X29. Q. Are you not liable to be mistaken as to melting point, if you go by the literature?

A. Not within the limits of experimental error.

X30. Q. Did you ever see any references in the literature to the melting of monophenylguanidine?

A. I have not.

X31. Q. If you saw one reference saying that monophenylguanidine has a melting point of 193, and another reference, saying that the same substance has a melting point of 60, which do you accept? The one that you consider the most authoritative?

By Mr. Edmonds:

I object, because it is irrelevant.

By the Court:

It is testing the knowledge of an expert witness.

(Question read.)

By the Court:

Your objection is to the general line of examination rather than to the form of the question, I take it?

By Mr. Edmonds:

Yes, sir. And it has no purpose except to save time.

By the Court:

I will overrule the question as put.

By Mr. Wooster:

What I want to see is whether this witness accepts what he reads in literature as the melting point, and what he takes when he sees two different melting points for the same substance.

A. In a case like that, first of all the authority of the man writing it would bear weight, but in a case of that sort it is probable that neither melting point would be accepted until independent work of my own, or some one else published, would tend to confirm it.

By Mr. Wooster:

X32. Q. If you see a substantial difference in the melting point given in the literature in different

references for the same subject, is it not likely that one or the other did not have what he thought he had?

A. Not necessarily. He may have an impure form of the same compound.

X33. Q. On this dibenzoylguanidine, referred to in this Exhibit "NN," what determinations of that did you make?

A. In preparing that compound, first of all the method of preparation, according to the well-known Schotte-Baumen syntheses, would lead one to the conclusion that this compound should be formed; second, the melting point as described in the literature was checked by the product that I obtained; third, its analysis in nitrogen checked the product which I obtained; fourth, its solubility in a series of five organic solvents checked the purity of the compound; fifth, the method of reaction as described in the literature was observed to be followed in this particular reaction.

X34. Q. Rather than saying that these determinations checked, will you give the figures that you obtained?

A. I don't remember them.

X35. Q. Have you got them with you?

A. I have not. I can tell the melting point.

X36. Q. Please do.

A. 265 degrees Centigrade.

X37. Q. Sharp melting point?

A. The compound I prepared was sharp melting point.

X38. Q. How much did you prepare altogether?

A. Approximately 30 to 40 grams.

X39. Q. What kind of a looking material was it?

A. Pure white.

X40. Q. Like sugar or salt or cotton, or what?

A. As it forms in an aqua salt, it has a flocculent white precipitate. The flocculent is cheesy, which is characteristic of this type of compound.

X41. Q. You simply dried it or washed it?

A. I washed it with hot petroleum ether.

X42. Q. What was your figure on nitrogen determination?

A. I haven't that here. It satisfied me as to checking this compound within the limits of experimental error.

X43. Q. How can you differentiate this compound from urea, which has a closely similar melting point?

A. By its nitrogen analysis.

X44. Q. Have you got any of the material which you prepared?

A. I gave a sample of it to Mr. Bridgwater.

X45. Q. Why did you not bring your records of this work and the figures you actually obtained?

A. As to analyses or melting points?

X46. Q. Everything you got?

A. I brought along all my records as to the method of preparation, and that was all I felt was necessary. I can send for the nitrogen analysis or have another one made.

X47. Q. Have you an extra sample of this material which you can give to the plaintiff for that and other determinations?

A. I have not; but I would be glad to make a sample by identical methods and give it to the plaintiff.

By Mr. Wooster:

I move to strike out this deposition as incompetent, because the witness has not brought the facts which he actually determined, but has stated his conclusions, and while he is obviously testifying in good faith, he is not bringing in here the facts with scientific accuracy that an inquiry of this nature demands.

By the Court:

The objection is overruled and an exception noted.

By Mr. Edmonds:

Defendant offers in evidence a copy of the Weiss patent 1,422,506, this being the patent that has been referred to from time to time as covering the process of making D. P. G. devised by Mr. Weiss, being Exhibit "QQ."

Defendant also offers in evidence all of the depositions taken in the National Aniline suit, that are referred to in the stipulation in this case heretofore offered in evidence. As a matter of convenience, we have agreed to use a printed volume of the record in the old case as prepared, and I suppose that volume can be marked as an exhibit as a whole, instead of each of the several depositions. In that volume is certain correspondence between Dr. Kratz and the Dovan Company, and I wish to offer that in evidence. I suppose my adversaries will agree that the copy in here is an authentic copy of the correspondence that took place. It is on pages 498, 499, 500 and 501.

By Mr. Wooster:

I object to the offer of this correspondence. The witnesses are here, and it seems to me that they should be called to testify here. There is no stipulation made that these matters from the other record could be so offered, and I do not think it is the way to do it.

By Mr. Edmonds:

That is perfectly true. If you do not agree to accept these, I will have to withdraw my offer. The originals are here, but it is somewhat more convenient to use the copies of the record.

By the Court:

Is the subject matter relevant, first of all?

By Mr. Edmonds:

I think it is relevant, because it reflects the position of Dr. Kratz. Immediately after this Weiss patent was issued, he wrote them and asked them what they meant by taking out a patent on something he had disclosed some four years before. They wrote him a letter, in which they said they would be glad to hear from him. Then they had some one write him, saying that the first letter was written for legal reasons.

By the Court:

Is there any admission on the part of the plaintiff in connection with that? I can hardly see, if there is not something of that nature in it, that the correspondence would be evidence.

By Mr. Edmonds:

If Mr. Wooster will not accept the letters, our discussion is beside the question, and I will withdraw the offer.

By Mr. Wooster:

I object, on the ground that they are wholly incompetent and immaterial. They relate to things that happened shortly after the patent was issued, and are not involved in this case at all.

By Mr. Edmonds:

I offer in evidence a sheet of chemical formulas of the substances that we have referred to, solely because I think it may help to enlighten this subject. If my adversary thinks any part of that is not entirely correct, I will allow him to change it, or withdraw the exhibit.

(Sheet marked Exhibit "QQ"—1.)

I offer in evidence a copy of the original affidavit of Mr. Daniels, in connection with one of the motions in the National Aniline case. This is the copy that was shown to Mr. Daniels when he was on the stand, and he stated it was his affidavit and he was questioned about it. I find, through oversight, it was not offered at that time.

(Exhibit "UU".)

I have here a copy of Richter's Chemistry, that was used by the Republic Rubber Company, and this is the book that Weiss and Carlton said they looked at when the conception of this invention is alleged to have taken place. I think it would be helpful, and I wish to have in the record, a copy of one page, and I now offer that.

I assume there is no objection to that. I will have copied page 88 in Richter's Organic Chemistry, the bottom portion of this page, beginning with "Phenylated Guanidine Derivatives":

"Phenylated Guanidine Derivatives (see vol. I, Guanidines).

Diphenyl-guanidine, $H\,N{:}C{<}^{NH.C_6H_5}_{NH.C_6H_5}$ (melaniline), melting at 147°, is produced by the action of cyanogen, chloride upon dry aniline, and by digesting cyananilid (p. 90) with aniline hydrochloride. It is, like guanidine, a mono-acid base. Carbon disulphide transforms it into sulpho-carbanilide and sulphocyanic acid.

a. Triphenyl-guanidine, $C_6H_5.\ N{:}C{<}^{NH.C_6H_5}_{NH.C_6H_5}$ melting at 143°, is obtained on heating diphenylurea or diphenyl-thiurea, alone or with reduced copper, to 140°. It is most readily prepared by digesting an alcoholic solution of diphenyl-thiurea and aniline, with litharge or mercuric oxide (or by boiling with an iodine solution). Heated with CS_2, it reverts again to diphenyl-thiurea and phenyl mustard oil.

B. Triphenyl-guanidine, $C{<}^{N(C_6H_5)_2}_{NH.C_6H_5}$, melting at 131°, is obtained by heading cyananilid with H Cl—diphenylamine. It decomposes into diphenylamine, phenyl mustard

oil, and sulphocyanic acid when heated with carbon disuphide."

By Mr. Edmonds:

In one of the early days of this trial, not long ago, there were some facts in connection with this interference that Weiss is involved in, and I stated on the record such simple facts as I thought would be accepted at once, and because of that, I did not go into details about that with Mr. Weiss. I now ask Mr. Wooster if he will accept as true the statement on pages 168 and 169 of the record. It is a very simple statement of things that are quite obviously accurate. Of course, if they are not, I will be glad to change them. I want an accurate statement to connect up the brief that has already been received in evidence with the testimony that has gone in about that interference.

By the Court:

You mean the record of the present case?

By Mr. Edmonds:

The record of the present case. There has been some examination of the witnesses about this interference, and a statement of the outstanding facts seems to be necessary to connect the two together. I put that statement on the record at pages 168 and 169, with the idea that counsel would at some time tell me whether he agreed that that is correct. Now, I ask him if he will do so.

By Mr. Wooster:

I make no objection to that statement of Mr. Edmonds as he gives it, but he has abstracted proceedings in a Patent Office record involving over 200 printed pages, for Weiss, and more than that number of printed pages for two other parties. I think the records are the best evidence.

By the Court:

Offer the record.

By Mr. Edmonds:

I have offered what I want. I put no limitation whatever on how much shall go in. If Mr. Wooster wants some more, or all of the rest, he may offer that. I have not offered anything I do not want; but there is no limitation on what he can do.

By the Court:

I don't know that he is required to do that. The force of it will be affected by the testimony offered.

By Mr. Wooster:

I raised no objection. Why not put the record in, and let either party use what they want from it?

By the Court:

It is not incumbent on counsel to admit the correctness of any portion of your case.

By Mr. Edmonds:

I will offer a copy of this Weiss record, because of Mr. Wooster's attitude. I accompany

this with a statement that it is useless to me, and, so far as I know, it will be useless to the Court, and for that reason I do not like to offer it in evidence. But since the matter is put up to me in that way, I now present this as an exhibit for the defendant. I think that there ought to be on the record some explanation of what this record refers to, and there would have been such a statement brought out from the witness Weiss, had it not been for the fact that I assumed a short statement of the connection between these two proceedings would readily be agreed to, and that is all that the statement on pages 168 and 169 is. The record is marked Exhibit "VV."

By Mr. Edmonds:

I call on plaintiff to produce the document called for during the course of the testimony of Mr. Brill.

By Mr. Wooster:

Plaintiff produces its copy of the contract referred to between itself, Perth Amboy Chemical Works and Graselli Chemical Company, and respectfully submits to the Court that that contract is privileged here, and should not be shown to Mr. Edmonds or any of his associates here. Certainly it is privileged as to the defendant, Corona Cord Tire Company, which up to now is the only party of record for the defendant. This three-party contract relates to a license agreement under a patent owned by the Graselli Company, No. 1,149,580, which is now in suit in the Southern District of New York, against National

Aniline & Chemical Company, which is represented by Mr. Edmonds and his firm. This inquiry for this contract here in this case appears to me to be merely a fishing excursion to discover something of possible use in the Graselli-National case than for any issue here. I submit the document to the Court, but I object to Mr. Edmonds seeing it.

The agreement I object to producing is a three-party agreement involving the Graselli Company under another patent. I here produce an agreement dated October 7, 1924, between the Perth Amboy Chemical Company and the Dovan Chemical Corporation, respecting the two Weiss patents that have been mentioned here, the one in suit and the other on the process of the patent just offered as defendant's exhibit.

By Mr. Edmonds:

That is still another paper. We were told that three papers evidenced the whole agreement. Evidently there is something else. This is the third paper that was said to evidence the remaining elements of this agreement that we wish to see. Among other things, I want to know whether this suit is being conducted because there is some provision that royalty is payable to somebody while they are still suing. If that is the reason this suit is brought and is prosecuted I would like to know it.

By Mr. Wooster:

I will say that royalty is not paid by anybody until this patent is held valid and infringed.

By Mr. Edmonds:

That is typical of the reason I must see these documents.

By the Court:

So far as I understand the relevancy of this particular matter, I do not think the other is essential, and I will hold that counsel is not required to produce this other agreement. As I get it, this third agreement is perhaps a change simply of the terms of payment, but is in no sense an abrogation of the license.

By Mr. Edmonds:

I can't reply directly to your Honor, because I don't know what is in that document; but among other things that are in it, is what the witness stated here, that in that document this Perth Amboy Chemical Company agreed to allow the Graselli Company to do something which it had no right to do, namely, to grant a license under some other patent to this plaintiff here.

By the Court:

After examining that agreement and considering it, I shall not require the production of that agreement. The plain matter is to show the license to the Perth Amboy Company, and the agreement produced for the inspection of the Court, in connection with the other contracts which were offered in evidence, is not one which affects the license to the first Perth Amboy Company. That is, it seems to me that while it may be collateral to a certain extent, it is not relevant upon the question here as to whether or

not the Perth Amboy Company did pay a license to the plaintiff company here. With so finding, I will rule that the plaintiff is not required to produce the contract, and will note an exception to defendant.

DEFENDANT RESTS.

GEORGE D. KRATZ, recalled on behalf of defendant in sur rebuttal, out of order, by agreement of counsel, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

395. Q. Doctor, is there any part of your testimony, as you gave it here on Monday or Tuesday, that you would change in any way, by reason of anything said by the two witnesses, Shaw and Hoffman, who have been produced here by the plaintiff?

A. No; there is not.

CROSS-EXAMINATION.

By Mr. Wooster:

X396. Q. Did the witnesses state it right, that the period of mixing was about forty-five minutes for each batch?

A. Thirty-five to forty-five minutes is right.

X397. Q. And were they right that each batch was about 100 pounds?

A. That is right; yes, sir.

X398. Q. And is Mr. Shaw right as to the T-8 formula being written in pounds and ounces as he got it from you?

By the Court:

Mr. Wooster, I don't know where we are going to end on this thing, if every time a witness is called to the stand he is called to repeat a lot of testimony. Now, of course, it will be accepted as right unless it is contradicted by other testimony. If they have not contradicted it, why take up the time?

By Mr. Wooster:

Well, he is in fact contradicting it by one blanket question.

By the Court:

No, he does not. I don't see why he was called at all. And if it was merely that the time of the Court was being taken up by repeating the testimony of half a dozen witnesses, I must say that I am going to stop your cross-examination.

By Mr. Wooster:

I don't see why Mr. Kratz is put back.

By the Court:

I don't either. It certainly is for no reason that you should turn in and have him repeat a lot of testimony given by your witnesses, which is not denied. I am getting clear out of patience with the way the time has been taken up.

By Mr. Wooster:

If your Honor comes to read this testimony, you will see it is pertinent.

By the Court:

Well, if it is not denied, what a witness says will be taken as the truth. And when he is called and asked a general question of that kind—which ought never to have been put to him I am free to say, and he ought never to have been called back on the stand, because he swore to all that, and unless he is called back to make some specific change, of course his testimony would stand. Now, if this is going to be an excuse for you to go ahead and get a lot of other stuff that has not been given by him, or if given, it already appears in the record, and take up the time in that useless way—This is getting quite on my nerves.

By Mr. Wooster:

Well, may I strike out my cross-examination?

By the Court:

You may leave it just as it is, and you may leave my remarks on the record just as they are; but I am telling you I don't want any more of that kind of cross-examination.

SUR-REBUTTAL.

ERNEST R. BRIDGWATER, recalled in sur rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Edmonds:

146. Q. Is this sample of diphenylguanidine produced by plaintiff's witness Williams a sample of the chemical article?

A. It is probably chemical in purity. I have no knowledge as to that, but the material often crystallizes in very coarse and dense crystals, and couldn't possibly be used as it is in the vulcanization of rubber.

147. Q. Is this sample that I now hand you the diphenylguanidine product, as actually used by manufacturers?

A. Yes. This is material that was precipitated in the regular rubber procedure.

148. Q. How much is in that bottle?

A. Five grams, exactly.

By Mr. Edmonds:

I offer in evidence the bottle identified by the witness as Exhibit "YY."

CROSS-EXAMINATION.

By Mr. Wooster:

X149. Q. What is the trouble with the sample offered by Mr. Williams?

A. It is a coarse, crystallized, unground product. It couldn't be used in rubber. It is not the material

he sells for use in rubber. If he were going to sell that, he would grind it.

X150. Q. Your objection to Mr. Williams' sample is that his crystallized as they were recovered, without being ground?

A. I presume that he was crystallizing under such conditions as would produce large crystals.

X151. Q. So that when you grind it the bulk increases?

A. Yes. The chemical product is always ground. Of course, you can make a wide variation in the density of the chemical product, that is, by pressing it, filter pressing it, and blowing it with air in the filter press, you can make it very dense.

X152. Q. This sample produced is one obtained within a few days and not such as might have been had in 1917, is it?

A. This is, I should say, such as might have been used in 1917. It was prepared in the laboratory some time ago.

X153. Q. Do you know what was put out in 1917, in the way of diphenylguanidine?

A. Not from my own knowledge.

DEFENDANT RESTS.

TESTIMONY CLOSED.

REBUTTAL.

By Mr. Kennedy:

At a previous session, Mr. Edmonds was asked by Mr. Wooster whether or not the Du Pont Company was paying the expenses of, and had control of, this litigation. That question Mr. Edmonds refused to answer. Thereupon we put on the stand Mr. Doty, for the purpose of showing that Mr. Doty had knowledge of the connection of the Du Pont Company with this litigation.

By the Court:

As I recollect it, I sustained an objection to the introduction of that particular proof, stating that if I had occasion to change my mind as to that I would so announce later in the case. Now, I am not certain that that is correct.

By Mr. Kennedy:

I find in the record here, "The Court: I doubt if the agency even has been established. I will for the present sustain the objection." Now, my sole purpose now is to call your Honor's attention to decisions that I didn't then have on this very point. One is by Judge Shiras, reported in 41 Fed. Rep., at 351. There the Court said:

> "In the brief filed by complainant, it is asked, in case a decree is ordered in favor of the complainant that the same in terms shall run against F. P. Mast & Company, a corporation created under the laws of Ohio.

From the evidence in the case, it appears that the defendants, ... and .....Miller, are the agents for Mast & Company in Iowa, and that the machines sold by them were manufactured by Mast & Co., and that the company, through its attorneys and agents, is in fact conducting the defense of the case. Under the rule recognized in *Lovejoy vs. Murray* (and some other cases that the Court referred to) it is clear that Mast & Co. will be as fully bound by the results of the present litigation as though the corporation was a party to the record, for it is made clear that the principal party in interest being the manufacturer of the machines sold by the defendants Miller and bound by contract with them to protect them against the consequences of infringement, it has had notice of the pendency of the suit, and in fact has assumed the control and management of the defense, and therefore, under the doctrine of the case just cited, the decree herein will be in fact binding upon the corporation. Another good reason is perceived by a statement in the decree, though it may not be made to appear upon the face of the decree, that in fact Mast & Co. is bound in the results reached in the prosecution of the litigation in which it has been actively engaged."

By the Court:

You asked me to do something more than that. Where it has not appeared in the course of

the testimony at all, you have asked us in this issue to try out another issue relative to the knowledge of that company, without that company receiving any notice of that inquiry, and then make a decree.

By Mr. Kennedy:

I don't ask for a decree. I do ask simply for this: that the fact as to the relationship of the Du Pont Company with this litigation, so far as the trial of it is concerned, should appear on the record here, so that we may urge estoppel in case we are successful against them, because, having the knowledge in the record here, we will have all that is necessary to proceed against them, and in doing so urge an estoppel. In other words, that they have had their day in court as to the validity of this patent and its infringement. All I ask for here is permission to show on the record here the connection of the Du Pont Company with this company.

Now, I was going to refer your Honor to a more recent case, that of *Dicks Press Guard Mfg. Co. vs. Bowen*, 229 Fed. Rep., page 196. In that case the dealer or user was sued, and the manufacturer appeared by its counsel, just as we believe the Du Pont Company has appeared here, and the Court said:

> "Is not this the effect of its voluntary appearance on the hearing and on the appeal?" (That is to say, that it should be noted in the record, or taken care of in the decree. I don't ask for that.) "Having

appeared and openly and avowedly assumed and conducted the defense thus far, it is bound by the order made, which is final during the pendency of the action. May not all this be evidenced by making the corporation a defendant on the record?" (I don't ask for that.) "And may not it be held to its appearance by now formally making it a party?" (I don't ask for that.) "It would seem plain that the Court ought to know what parties, either complainant or defendant, are before it and entitled to be heard, and that the record itself should show this." (That is what I ask for.) "One of the most vicious things connected with a litigation, either civil or criminal, is the operation of influences from, and the recognition of, interested persons not appearing as parties on the record. Those who are to be heard at all and recognized in bringing out and considering the merits of a controversy should be parties of record, and personal appearance by an attorney and participation in the litigation ought to be treated as equivalent to a formal written appearance in the case."

Now, I am asking for much less than the Court in that case decided they were entitled to.

By the Court:

That seems to have been a different situation than exists here.

By Mr. Kennedy:

I would ask that we be permitted to proceed with the examination of Mr. Doty.

By the Court:

Your idea would be that the Court would have to find that as a matter of fact. Certainly, if you introduce testimony like that, without any finding on the part of the Court, it would have no effect.

By Mr. Kennedy:

I will not ask for any finding of fact on that. The only thing I want to do is to have a record here of the real situation as to who is conducting the defense here. I will not ask for finding of fact.

By the Court:

There is to be no finding of fact. That is purely a work of supererogation of the Court in taking up its time, in the hearing of any such testimony. Testimony is introduced purely for the only purpose of enabling the Court to decide the issues of fact which have been raised by the pleadings in that cause. I will have to sustain the ruling, that I understand the record already shows.

By Mr. Wooster:

I offer a stipulation respecting a quotation to be used here from the application of Morris L. Weiss, filed July 2, 1921, for a process of making diphenylguanidine, together with a stipulation regarding depositions of Edward W. Vaill, to be

used here, taken from pages 361 and 362, of the National Record, and a stipulation respecting use of the National Record here. I ask this be copied into the record:

"STIPULATION

IT IS HEREBY STIPULATED AND AGREED by the parties hereto, by their respective counsel, as follows:

The application of Morris L. Weiss, Serial No. 482,143, filed July 2, 1921, entitled 'Process of Making Diphenylguanidine' as filed in the United States Patent Office on July 2, 1921 contained the following:

Diphenylguanidine is indicated by the formula $C< \begin{matrix} NH, C_6H_5 \\ = NH \\ NH, C_6H_5 \end{matrix}$

The object of my invention is the production of this substance in large or commercial quantities so that the same may be available in the chemical industries and particularly as an accelerator in the vulcanization of rubber compounds."

that the said application was officially allowed under date of December 19, 1921; that the said application was thereafter amended under date of February 17, 1922, by adding to the above quoted paragraph the following:

"as set forth in my co-pending application serial No. 514, 727, filed November 12, 1921, for Vulcanization Accelerators."

The amended paragraph appears at lines 10 to 23, inclusive, of the Weiss patent 1,422,506 granted July 11, 1922.

"IT IS FURTHER STIPULATED that as a portion of plaintiff's case herein, the deposition of Edward W. Vaill when recalled for plaintiff in the suit of this plaintiff against National Aniline & Chemical Company, Inc., as printed on pages 361, 362 of the Transcript of Record in said suit, together with the Exhibits referred to by him, may be offered and received in evidence herein and shall be given the same force and effect herein as if said Edward W. Vaill were produced, sworn, and so testified herein.

IT IS FURTHER STIPULATED SUBJECT to Correction should error appear, that a printed, uncertified copy of the Transcript of Record in *Doran vs. National Aniline & Chemical Co. Inc.* may be used with the same force and effect as a certified copy, subject to all other objections by either party being reserved.

J. S. WOOSTER,
Counsel for Plaintiff.

PENNIE, DAVIS, MARVIN, EDMONDS,
Counsel for Defendant.

Dated New York,
Oct. 5, 1925."

PAUL A. SHAW, a witness called on behalf of plaintiff, in rebuttal, having been duly sworn, testified as follows:

DIRECT EXAMINATION

By Mr. Wooster:

1. Q. Were you ever employed at the Falls Tire & Rubber Company?

A. Yes, sir.

2. Q. In what capacity and between what dates?

A. As compounder, from 1915 to 1918.

3. Q. When did you leave in 1918?

A. Around the latter part of May.

4. Q. Where did you go after leaving there?

A. To the Firestone Rubber Company.

5. Q. Was Mr. George D. Kratz employed by the Falls Rubber Company while you were there?

A. Yes, sir.

6. Q. When did he come?

A. In 1917.

7. Q. When did you first take the position of compounder?

A. In June ,1915.

8. Q. And you held it continuously until you left?

A. With the exception of about six or eight months.

9. Q. Who held it then?

A. Charles Smith was there a few months.

10. Q. From what period was he there as compounder?

A. He came around the first of the year 1917,

and left about the latter part of May or the first of June.

11. Q. How do you fix the date as to when Mr. Smith left?

A. He left about the time of the first registration for the army.

12. Q. What did he go into when he left?

A. He went to work on his father's farm for a short time.

13. Q. From and after the time Mr. Smith left, who did the compounding?

A. I did.

14. Q. Who else did the compounding?

A. No one.

15. Q. Will you state what the work of compounding consisted in?

A. It consisted of weighing out the amounts of rubber and pigments that went into the different batches.

16. Q. How did you learn how much of each to weigh?

A. We had a written formula that we went by.

17. Q. Where did that formula come from?

A. From the superintendent and Mr. Kratz.

18. Q. In what shape did it come?

A. On a card.

19. Q. Giving the ingredients and how much of each to use?

A. Yes, sir; in pounds and ounces.

20. Q. How much did these add up to?

A. 100 pounds.

21. Q. Was that the uniform practice?

A. It was on the larger mill that we had.

22. Q. What was the practice as to tube compounds?

A. They weighed the same amount.

23. Q. What is that?

A. 100 pounds.

24. Q. You call those 100 pound batches?

A. Yes, sir.

25. Q. And your work was to weigh up the ingredients in pounds and ounces to make up 100 pound batches?

A. Yes, sir.

26. Q. Then what became of those batches?

A. They were taken out to the mixing mills and mixed.

27. Q. How long did it take to mix?

A. About forty-five minutes.

28. Q. That is, a mill is a machine with heated rolls between which the batch is dumped and rolled around until it is mixed?

A. Yes, sir.

29. Q. Did you ever handle any accelerators?

A. I did.

30. Q. What ones?

A. Mannose.

31. Q. Is that the only one?

A. Yes, sir.

By Mr. Wooster:

I stated the other day that we would show the composition of mannose, but as Mr. Kratz did not desire it disclosed, the same will not be disclosed.

32. Q. Was it part of your work to weigh out the accelerator?

A. Yes, sir.

33. Q. Can you name some of the substances which you handled to go into these tube batches?

A. That was rubber and zinc and green oxide, mannose and paraffine, in some batches.

34. Q. And magnesia?

A. In some we did, yes.

35. Q. Litharge?

A. Not in tubes.

36. Q. How many kinds of tubes did you have compound formulas for in the summer and fall of 1917?

A. You mean, how many kinds of tubes we made?

37. Q. Yes.

A. We made green, red and gray.

38. Q. What was the name of the gray tube formula?

A. The number of the compound?

39. Q. Yes.

A. "T"-8.

40. Q. Will you look at this formula which I show you, and state what it is?

A. That is my copy of the original "T"-8 Compound.

41. Q. Where did you get that notation "T"-8 from?

A. That was written on the original compound.

42. Q Did you ever hear of a grey tube stock in your compounding room, known as 62 or 63 or 63 modified?

A. No, sir.

43. Q. On this formula you have "first latex,"

followed by "latex X". Then a dash, then a zero, then a "oz". What does that mean?

A. The "oz"?

44. Q. Yes, the whole thing. What is that cross?

A. The first column is pounds and the next column is ounces.

By Mr. Wooster:

I offer the "T"-8 formula in evidence as Exhibit No. 13.

45. Q. Did you ever make up that "T"-8 compound?

A. Yes, sir.

46. Q. Under whose instructions?

A. Mr. Kratz's.

47. Q. Do you recall an instance where tube stock formulas were not exactly followed?

A. No, sir, I do not.

48. Q. What was your practice in making them up?

A. To put them up just as it was written on the card.

49. Q. Did anyone ever instruct you in making up "T"-8 compound to vary any of the ingredients, and if so, which ones?

A. I can't remember of anyone telling me to leave anything out, or anything.

50. Q. Were you ever told to change any of the proportions as given here?

A. If there was any change made, there would be a new card written out.

51. Q. Would that card have the same stock number or be given another number?

A. It could be done either way.

52. Q. Were you ever instructed to change the amount of magnesia in this T-8 formula?

A. No, sir, I never changed anything myself.

53. Q. Have you any recollection of increasing or reducing the eight ounces of magnesia given in this formula?

A. No, sir.

54. Q. Do you recall any instance where Mr. Kratz instructed you to vary this formula?

A. No, sir.

55. Q. After you made up the batch of 100 pounds and it was milled, what was done with that milled batch?

A. It was put on a skid, as we called it, after it was cooled somewhat, and then it was ready for the calender.

56. Q. Was it handled as a 100 pound batch or several batches handled at once, or in less than 100 pound pieces?

A. In 100 pound batch, when it was taken off the mill, it would be taken off in three or four pieces, and this was all piled together on a skid.

57. Q. Did you ever watch the milling?

A. Yes, sir, I have.

58. Q. Did you ever see Mr. Kratz put anything into the batch on the mill?

A. No, sir.

59. Q. Were these pieces of the batch called slabs?

A. They could have been called slabs.

60. Q. After these pieces of a 100 pound batch came from the mill, you said they went to the calendar?

A. Yes, sir.

61. Q. Did they go to any machine before going to the calendar?

A. Yes, sir; they went to the mill that was called the warming up mill.

62. Q. Now, if there was any change in formula for one, two or more batches, where would that change first manifest itself?

A. In the compounding room.

63. Q. That is, what would be done?

A. I just don't understand your question.

64. Q. You said the change would appear first in the compound room. Would any record be made of the change or any indication?

A. Well, if the compound is being changed, we would probably have another card made out.

65. Q. I mean, if you were making up some batches of T-8 and other batches of T-8 with a slight change in it, would you mark the batch tubs?

A. We would have to mark them sort of a special batch, that way.

66. Q. But you might not mark the regular T-8 batches?

A. Not the ones that were put up according to the regular formula, no, sir.

67. Q. Why would that be?

A. As long as they were not special batches, there wouldn't be any reason to mark them.

68. Q. How could you tell what it was?

A. How could I tell?

69. Q. Yes.

A. I could probably tell by looking at it.

70. Q. You mean, you could tell the different compounds apart by appearance?

A. Yes, sir.

71. Q. Have you any recollection of any T-8 batch or similar batch being marked with a red tag

A. No, sir.

72. Q. Did you ever see any red tags in your compound room?

A. Not any red tags, no, sir.

73. Q. What kind of tags did you see?

A. We used a small white tag.

74. Q. What was marked on that tag?

A. Showed the number of the compound.

75. Q. Who made the mark?

A. The mill man that mixes the compound.

76. Q. How did he know what to mark on the white tag?

A. Well, he would know the different numbers that we were running at that time. If he wouldn't know himself, I would tell him.

7. Q. So if there was any difference in batches, it was the duty of the mill man to mark the tag accordingly?

A. Yes, sir.

78. Q. Do you recall the names of any who worked on the mills at that time?

A. Joe Hoffman, Albert Rominsky, Albert Schmidt.

79. Q. How long since you had anything to do with the personnel of the Falls Rubber Company?

A. Since May, 1918.

80. Q. Do you know if any of the people that you have named are still employed there?

A. I think that one of them is still there.

81. Q. In order to put a special accelerator into a batch being worked on the mill, would the person putting the special accelerator in have to wait around for forty-five minutes, while one batch was being milled, before putting the same thing in another batch, or would he put the stuff in and then come back?

A. He could put it in while they were putting in the compound in the rubber, or he could drop it in a tub, or he could wait around for forty-five minutes until they got ready for the next batch,—either one.

82. Q. But there would be a period of forty-five minutes, or thereabouts, between successive batches?

A. Yes, sir.

83. Q. Did you ever hear of a master batch?

A. Yes, we have a master batch.

84. Q. What was a master batch?

A. Mannose.

85. Q. That was a mixture of rubber and accelerator?

A. Yes, sir.

86. Q. How was the master batch used?

A. We used a certain amount of it according to the compound, whatever the weight was that Mr. Kratz wished to use.

87. Q. What was the ordinary way of introducing the accelerator into tube compounds—by a master batch or some other way?

A. Up until the time Mr. Kratz came, we didn't have a master batch.

88. Q. At about August or September of 1917, what was the way of putting the accelerator into the batch?

A. We used mannose at that time. It was mixed up into the raw rubber.

89. Q. And weighed quantities of this raw rubber or master batch put in ?

A. Yes, sir.

CROSS-EXAMINATION.

By Mr. Edmonds:

X90. Q. You have mentioned the names of three men. Are those the only ones you remember, or are they all that there were?

A. These three men we had upstairs. We had two in the basement. I can recall one man's name, McCoy, and there was a foreign name.

V91. Q. Those five men were the only mill men the whole time you were there?

A. Well, we had down in the basement several men come and go.

X92. Q. You don't remember any of their names?

A. No, sir. They were mostly foreigners.

X93. Q. How many were there?

A. Down in the basement?

X94. Q. How many of these other mill men, in addition to these five were there?

A. I would say we had two or three.

X95. Q. These five men that you have mentioned, were they there all the time that you were there, from 1915 to 1918?

A. No, sir.

X96. Q. Which ones were not?

A. Albert Schmidt was not there, and this man McCoy was not there all the time.

X97. Q. Who was in their place when they were not there?

A. Before we came to the new plant we only had two mills, and then in the new plant we had two at first and one later, and then the other mills were moved over, so there was a period of time when we didn't need five mill men.

X98. Q. How many mills did you have in the middle of 1917?

A. I would say we had five.

X99. Q. Your job was the compounding?

A. Yes, sir.

X100. Q. There were various receptacles with substances in them, and you would get a paper that said so many pounds and ounces of this, that and the other, and you would get those things out and put them together and you would weigh them?

A. Yes.

X101. Q. And then that mass that you had brought together, you would send to the mill man?

A. Yes.

X102. Q. That was your job day after day and week after week?

A. Yes, sir.

X103. Q. How many batches do you suppose you mixed each day?

A. Well, we could probably run in the neighborhood of forty batches a day.

X104. Q. That you yourself compounded?

A. Yes, sir.

X105. Q. And in the course of a week that would be around 256 batches?

A. Yes.

X106. Q. And that kept up through your whole period of employment?

A. Yes, sir.

X107. Q. Now, if we made a calculation and found that in the course of your employment you mixed up ten thousand of those batches, would you undertake to tell us what happened to every one of those ten thousand batches after they left your compounding room?

A. No, sir.

X108. Q. When you sent the tubs out of the compounding room you didn't know which mill they were going to, did you?

A. Yes.

X109. Q. You knew which mill?

A. Yes, sir.

X110. Q. And which mill man was operating that mill?

A. At that time, yes, sir.

X111. Q. And would you undertake to tell us

which mill each of these ten thousand batches went through and what man operated it?

A. I couldn't tell all those batches, no, sir.

X112. Q. At which mill did Hoffman work?

A. He worked on what you would call No. 3 —counting the compounding room No. 1, he worked on No. 3.

X113. Q. All the time you were there?

A. Practically all the time, yes, sir.

X114. Q. I understood you to say that you were out of the Falls Company employment for six or eight months.

A. No, sir.

X115. Q. Your employment was continuous from 1915 to 1918?

A. Yes, sir.

X116. Q. Was it a part of that time that you were not employed in the compounding room?

A. Yes, sir.

X117. Q. Where were you employed then?

A. I was then in Mr. Barbour's office. He was superintendent at that time for a few months.

X118. Q. You were in his office?

A. Yes, sir.

X119. Q. What work were you doing there?

A. I made various records for Mr. Barber, and also for the office.

X120. Q. And that continued for six or eight months?

A. Approximately, yes.

X121. Q. When was that?

A. It was in the early part of 1917, and possibly a month in 1916.

X122. Q. Aren't you mistaken about that? It was later in 1917 than that?

A. Later than 1917?

X123. Q. Yes?

A. No, sir.

X124. Q. Mr. Barbour left the employ of the Falls Company, didn't he? He was dismissed from the employ of the Falls Company?

A. Yes.

X125. Q. When was that?

A. I couldn't give the exact date. I think it was in the year 1917, however.

X126. Q. Did your employment up there in Mr. Barbour's office continue after he left, or did that end your period there?

A. I was in the compounding room when Mr. Barbour left.

X127. Q. You had already gone back there before he left?

A. Yes, sir.

X128. Q. How many men were there employed in the compounding room?

A. One.

X129. Q. You were the only man?

A. Yes, sir.

X130. Q. Who was the man while you were not in there, while you were up with Mr. Barbour?

A. Charles Smith.

X131. Q. This record that you have produced here, is a copy of one of the Falls Company's formulas that you made and appropriated to your own use?

A. Yes, sir.

X132. Q. Did you have copies of all the other formulas?

A. Yes.

X133. Have you got them now?

A. Yes, sir.

X134. Q. You still have all of them?

A. Yes, sir.

X135. Q. Haven't shown them to anybody?

A. I have, yes, sir.

X136. Q. Have you sold any of them?

A. No, sir.

X. 137. Q. Formulas of this sort came to you on cards from Mr. Kratz?

A. Yes, sir.

X138. Q. And this is just the way in which they came to you, so many pounds of each and so many ounces of each of these several ingredients?

A. Yes, sir.

X139. Q. And your job was to read here where it says, 27 pounds of so-and-so, and you would get out 27 pounds and put that in the mix?

A. Yes.

X140. Q. And you would do that with each of these eight or ten substances, and then you were through?

A. Yes. I would take it to the mill.

X141. Q. Have you any recollection of a substance that was known as No. 700?

A. No, sir.

X142. Q. You don't know what that was?

A. No, sir.

X143. Q. You would know what it was if you had ever used any of it, wouldn't you?

A. I probably would.

X144. Q. If you don't know what it was, you are quite sure that no such thing was ever used there?

A. I don't recall any 700.

X145. Q. But you said you would know if any 700 was used in that plant or ever compounded into a rubber mix. If you don't know of the use of any such thing, it must be that no such thing was ever used? Are you able to say whether any such thing as 700 was ever used?

A. I never heard of it being used, no sir.

X146. Q. If it had ever been used in that plant, you would know about it?

A. If it went through the compounding room I would have known about it, yes, sir.

X147. Q. If any such thing as that whatever went through the compounding room, you would be able to tell us now what that was?

A. I undoubtedly would.

X148. Q. Then you know that no such thing as No. 700 was ever compounded there while you were the compounding man. Is that a fact?

A. Yes, sir.

X149. Q. You are just as sure of that as you are of anything else you testified to, aren't you?

A. I am sure I never heard of it.

X150. Q. But you said it never was used. Is that still your testimony?

A. I am sure that I never used it, yes, sir.

X151. Q. You were the only compounding man, no one else could have used it?

A. Yes, sir.

X152. Q. No one else could have used it. Is that your testimony?

A. It may have been used in the laboratory.

X153. Q. I am talking about the compound that went into the factory. If any such thing as 700 were used in a compound that went into the mill room, you would know about it?

A. Yes, sir.

X154. Q. And, since you don't know about it, you know that it was not used?

A. It must not have been.

X155. Q. You still think you were back in the compounding room after your employment in Mr. Barbour's office, some time in 1917, even though you can't fix the date?

A. Yes, sir; I went back in the compounding room.

X156. Q. Then you know you were in the compounding room in 1918?

A. In 1918.

X157. Q. Yes?

A. In 1918 I was in there for a month or two.

X158. Q. For what months of 1918?

A. I would say in January and February, and possibly some of March.

X159. Q. What did you do when you left there?

A. I worked in the laboratory for a short while.

X160. Q. So you left the compounding room and went into the laboratory a little while before you left in May of 1918?

A. Yes, sir.

X161. Q. And you were in the compounding room in January and February and part of March?

A. I wouldn't say as to how much of March. I was in there a month or two after I got through breaking in a new man.

X162. Q. You were the only compounder in that room in those months of 1918?

A. Well, outside of the man that I was breaking in, yes, sir.

X163. Q. If you were breaking him in, you knew everything that he did?

A. Yes, sir.

X164. Q. So, except for this man with whose work you were entirely familiar, you were the only compounder during those months in 1918?

A. Yes, sir.

REDIRECT EXAMINATION.

By Mr. Wooster:

165. Q. Before you testified here did you discuss the matter of your testifying with any officer of the Falls Rubber Company?

A. I did, yes, sir.

166. Q. With whom?

A. Mr. M. J. O'Donnell.

167. Q. Did he object to your testifying here and discussing that T-8 formula?

A. No, sir, he did not.

JOSEPH HOFFMAN, having been produced on behalf of plaintiff in rebuttal, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. Were you ever employed at the Falls Rubber Company?

A. Yes, sir.

2. Q. When?

A. In 1913.

3. Q. To when?

A. Until 1919.

4. Q. In what position?

A. Mill man, at the calendar.

5. Q. You were on the calendar in the mill room.

A. No, sir, on the mill.

6. Q. What did that machine do?

A. Warming up.

7. Q. Warming up what?

A. The stock.

8. Q. Where did that stock you got come from?

A. It came from the skids. They were on the skids when we got them.

9. Q. And how had that stock gotten on the skids?

A. From the mixers in the mixing room.

10. Q. Was the stock on the skids in batches or pieces, or in what form?

A. They were in batches.

11. Q. How much was in a batch?

A. One hundred pounds to a batch.

12. Q. Was it all in one piece or several pieces?

A. There was from five to six or seven hundred pounds on a skid.

13. Q. That would be the result of several batches?

A. Yes, sir.

14. Q. From the mill?

A. Yes, sir.

15. Q. Several batches on the mixing mill?

A. It depends on what batches you would mix. If you were mixing five or ten, you would put that many on the skids.

16. Q. What was the weight of a batch of tube stock?

A. One hundred pounds.

17. Q. So you would get on the skids which came to your warming mill, the equivalent of several batches of tube stock?

A. Yes, sir.

18. Q. What did you do with it?

A. Warmed it up.

19. Q. Then what did you do with it?

A. Had a man there to take it and carry it over to the mill, the calendar.

20. Q. How many batches did the calendar require in order to operate?

A. About two batches, to run the calendar. You couldn't run the calendar without having two batches.

21. Q. You mean you had to keep at least two batches in there to make it run?

A. Yes.

22. Q. What did you call that in terms, that you kept there?

A. For a bank.

23. Q. Was it common practice for separate stocks as small as two batches, to come through?

A. No, sir.

24. Q. In tube stocks, I mean.

A. No, sir.

25. Q. Did you know Mr. George D. Kratz?

A. Yes, sir.

26. Q. What was your position when he came there?

A. On the mill, warming up.

27. Q. And for the six months succeeding, what were you doing?

A. Still warming up.

28. Q. How far was your warming up mill to the mixing mill?

A. About ten feet apart.

29. Q. How many mixing mills were there?

A. Five.

30. Q. Do you remember any of the operators of those mixing mills in August and September, 1917?

A. Albert Rominsky and Albert Schmidt.

31. Q. Did all of these five run at once?

A. Two of them were down in the basement; the other three were up where I was.

32. Q. Who were the men on the other three mills in your room, in August and September, 1917?

A. That was Albert Rominsky and Albert Schmidt.

33. Q. Did Mr. Kratz come around that mill room?

A. Up and down, yes, sir.

34. Q. What did he do when he came there?

A. Nothing that I noticed. He walked around.

35. Q. Did he give orders to the men operating the machines?

A. No, sir.

36. Q. Who was the superior of the mill men?

A. Well, the mill men would get orders from the foreman.

37. Q. Who was the foreman in August and September, 1917?

A. Hoover Brady.

38. Q. Did you ever see Mr. Kratz watch a mixing operation?

A. He just went around and looked around.

39. Q. Did you ever see him put powders into compounds being mixed?

A. No, sir.

40. Q. How were batches marked or tagged, if at all?

A. A small white tag and marked with yellow crayon.

41. Q. What was on the tag?

A. The number of the stock.

42. Q. Did you ever see any red tags on stocks going through the mill room?

A. No, sir.

CROSS-EXAMINATION.

By Mr. Edmonds:

X43. Q. You at your warming-up mill received the rubber from these mixing mills?

A. Yes, sir.

X44. Q. And there were five of those mixing mills?

A Two of them downstairs, and three up where I was.

X45. Q. Did you watch all five of those mills all the time you were running them?

A. No, sir.

X46. Q. There may have been some going on at some of those in the course of several years, you didn't see?

A. I never seen them, unless I went down to see.

X47. Q. Were you ever sick in your life?

A. Well, I wasn't sick. I stayed away one day or so.

X48. Q. You might have stayed away a day in 1917?

A. Yes.

X49. Q. And might have stayed away two days?

A. No.

X50. Q. You couldn't have stayed away two days?

A. No. I stayed away about one day.

X51. Q. You may have taken a day off once in a while?

A. No.

X52. Q. Never took a day off?

A. No.

X53. Q. Just stayed there watching those five mixing mills?

A. I only watched the three.

X54. Q. Didn't watch the one you were working on?

A. That is the three.

X55. Q. Did you ever watch this warming-up mill you were working on?

A. I kept on watching, and I had a lot of spare time.

X56. Q. The spare time you devoted to watching these other three mills?

A. Anybody could walk along there. They were right close to me when I dropped them down.

X57. Q. What have you been doing since 1919?

A. Still working at the Marathon Rubber Company.

X58. Q. Have you been with the company since you left the Falls Rubber Company?

A. No, sir.

X59. Where else have you worked?

A. Oh, as a roustabout. I didn't do much of anything.

X60. Q. For a time you were a general roustabout?

A. Yes.

X61. Q. Didn't do much of anything?

A. No.

X62. Q. What time was that?

A. I couldn't say. I worked at different places, worked around carpentering, shoveling and such stuff as that.

X63. Q. Were you running this warming-up mill the whole time that you were with the Falls Company from 1913 to 1919?

A. No, sir.

X64. Q. What else did you do?

A. I was mixer at the old plant.

X65. Q. You mean the compounder, what your associate here called the compounder. Is that what you were doing?

A. How is that?

X66. Q. I say, by mixer do you mean the same as this Paul Shaw meant when he said compounder?

A. No.

X67. Q. What were you doing?

A. I was mixing.

X68. Q. Mixing what?

A. On the mill, the stock.

X69. Q. When did you do that?

A. In 1913 I started.

X70. Q. When did you stop?

A. I don't just remember just the year that we moved from the old factory over to the new plant. I don't remember.

X71. Q. Did you continue to do that as long as you stayed in the old plant?

A. Yes, sir.

X72. Q. And then when you went into the new plant, you started on this warming-up mill.

A. Warming-up, yes, sir.

X73. Q. And that meant operating this warming-up mill?

A. Yes, sir.

X74. Q. How many other mills were there at that time?

A. Two up and two down.

X75. Q. That is, when you started up at the new plant?

A. Yes, sir.

X76. Q. And when did you get another one?

A. I don't know. Just about a year or so later. I don't know exactly how long after.

X77. Q. It may have been three or four years?

A. No, it wasn't that long.

X78. Q. Within a year.

A. Well, something like that.

X79. Q. Something like a year?

A. Yes.

X80. Q. And that was two upstairs with the three other men?

A. The other two.

X81. Q. There must have been about four years that you were working in the new plant. Is that about right?

A. I don't exactly remember. I can't remember. I wouldn't say one way or the other. I can't remember just how long we were there.

X82. Q. Do you mean to say that in that period of four years, you never missed more than one day at a time from your work?

A. Well, I know that at that time, in 1917, I was in good health. I don't believe I missed but one or two days.

X83. Q. You didn't miss more than one or two days in 1917?

A. No, sir.

X84. Q. Are you sure you never were sick?

A. Not at that time, no.

X85. Q. Never were sick in 1918?

A. Yes.

X86. Q. You were sick in 1918?

A. Yes, sir, I was.

X87. Q. For how long?

A. About three or four days, at that one time.

X88. Q. So you were out from work three or four days?

A. Yes.

X89. Q. When in 1918 was that?

A. If I am not mistaken, it was in the fall.

RECESS.

AFTERNOON SESSION.

Thursday, October 15, 1925.

JOSEPH HOFFMAN resumes the stand.

CROSS-EXAMINATION (Continued).

By Mr. Edmonds:

X90. Q. In operating this warming-up mill, didn't you have to watch the operation of the mill pretty closely, in order to guard against injury?

A. Well, I was so used to it that I didn't pay much attention to the mill.

X91. Q. Didn't have to pay much attention to the mill?

A. No.

X92. Q. You know of many individuals having fingers nipped off in running that mill?

A. Oh, yes—saw lots of them.

X93. Q. But you were so expert you could look around the room and still run the machine?

A. Yes.

X94. Q. And that is what you did most of the time?

A. Yes, sir.

X95. Q. In fact, that is what you were finally dismissed from the company's mill for, wasn't it?

A. No, sir.

X96. Q. It wasn't for looking around the room when you should have been?

A. No.

X97. Q. Something different. Didn't you have to keep this warming mill running pretty fast?

A. I couldn't run it any faster than it would go.

X98. Q. No, but you had to keep it working pretty regular, in order to supply the calendars?

A. I kept it in, yes.

X99. Q. You had to keep the machine busy practically continually, didn't you, to turn out a sufficient supply?

A. I didn't have to spend much time on that.

X100. Q. I didn't hear you?

A. I didn't have to spend much time on that.

X101. Q. It didn't take much time to do that?

A. No.

X102. Q. Did I understand you to say that the batches run through the calendar were 200 pound batches?

A. Well, there were no 200 pound batches run through the mills, but it took 200 pounds to keep that one mill running.

X103. Q. How much was run through the calender at one time?

A. Well, enough there to make a roll.

X104. Q. You don't know how much it was?

A. That was about—I wouldn't say just exactly how much—how much the roll weighed after it was finished.

X105. Q. You don't know how much was in a batch that went through the calender?

A. No, sir; never paid no attention.

By Mr. Wooster:

X106. Q. What kind of stocks were milled on those two mills that were downstairs?

A. Black tread stocks.

PAUL A. SHAW, recalled for further cross-examination, testified as follows:

CROSS-EXAMINATION.

By Mr. Edmonds:

X168. Q. As I recall, you said that you were in the office of Mr. Barbour for a certain time, which I think you said was six or eight months. Is that correct?

A. It was possibly about that length of time, yes, sir.

X169. Q. Now, when did that period of service in Mr. Barbour's office end?

A. About the time, or a little before the time, of the first registration for the war, which was in June, 1917.

X170. Q. Now, when was it with relation to the time when Mr. Barbour severed his connection, or had his connection with the company severed?

A. I can't recall just what time Mr. Barbour left the company.

X171. Q. Yes, but were you in the office there with him at the time his employment came to an end?

A. No, sir.

X172. Q. How long before his employment came to an end did you stop?

A. I couldn't say.

X173. Q. You don't know anything about that?

A. I don't know when he left there.

X174. Q. When did you leave the office and go into the compounding room?

A. Around the latter part of May or first of June.

X175. Q. Was that while Barbour was still superintendent?

A. Yes, sir.

X176. Q. How long before his superintendency came to an end?

A. Well, I don't know when he left there.

X177. Q. You don't know how much longer he continued there after you went back to the compounding room?

A. I can't recall; no sir.

X178. Q. Who took your place in the compounding room when you went into the office?

A. In Mr. Barbour's office?

X179. Q. Yes?

A. Charles Smith.

X180. Q. Did you say that mannose R was the only accelerator used in that plant?

A. Yes, sir.

X181. Q. That was the only one?

A. Yes, sir.

X182. Q. Never heard of thio. being used?

A. No, sir.

X183. Q. In fact, you know it was not used.

A. Yes, sir.

X184. Q. And you never heard of an accelerator by the name of gum No. 3?

A. An accelerator?

X185. Q. Yes?

A. No, sir.

X186. Q. You know that no such article as that was used?

A. I beg your pardon?

X187. Q. Do you know that no such article as gum No. 3 was used in the compounding of batches?

A. Not as an accelerator, no, sir.

X188. Q. Was there such a thing as gum No. 3 used?

A. I wouldn't say positively, but I think we had sort of a cheap rubber that might have been called gum No. 3.

X189. Q. You don't know whether it was or not?

A. I wouldn't say positive, no, sir.

X190. Q. But if it was used, it was not an accelerator?

A. No, sir.

X191. Q. You said, I believe, that magnesia was used only in tubes, did you not?

A. No, sir.

X192. Q. What was it used in besides tubes?

A. We used magnesia in our friction.

X193. Q. What else?

A. I think we used it in bead stock—I can't just recall.

X194. Q. What else?

A. I couldn't say anything else.

X195. Q. Do you know anything that it was not used in?

A. I couldn't answer that just offhand.

X196. Q. Have you got any other T-8 formulas of the Falls Company?

A. Have I?

X197. Q. Yes; or a copy of them?

A. No, sir.

X198. Q. That one you produced is the only one you have?

A. Yes, sir.

X199. Q. Did you have it in the mill room from time to time?

A. Yes, sir.

X200. Q. Your duties as a compounder took you in there quite a bit?

A. Yes, sir.

X201. Q. Now you said that you had to measure out all of the ingredients that went into a rubber

batch, and that were called for by these cards? Is that right?

A. Yes, sir.

X202. Q. Every one that was on the card you yourself measured up?

A. Yes, sir.

X203. Q. Did you ever measure out any of the substance called rosin oil?

A. I didn't measure it by weight.

X204. Q. I say, did you do it?

A. No, sir.

X205. Q. You didn't do that?

A. No, sir.

X206. Q. Then you didn't measure out all the things that went into batches?

A. We never used rosin oil, as what you call part of the compound—in fact, we didn't use rosin oil all the time.

X207. Q. Did any of the cards that you saw specify rosin oil?

A. I don't remember.

X208. Q. But you know that if they did specify rosin oil, you didn't measure it out?

A. I took it to the mill, and they would have a little can there that they used, that they would measure it out themselves—I think about a quart.

X209. Q. The mill man would do that?

A. Yes, sir.

X210. Q. Now, in the period of your employment with the Falls Company were you ever absent?

A. Not very often.

X211. Q. Were you ever absent?

A. I would say that I may have been for a half day or a day.

X212. Q. Were you ever sick enough in those three or four years to be absent from the office—from the shop—for a day?

A. To be absent how?

X213. Q. I say, were you ever sick during that period of three or four years—sick enough to be absent from the plant for a day?

A. Not that I recall.

X214. Q. You may have been, but you don't recall?

A. No, sir.

X215. Q. Ever take a vacation?

A. No, sir.

X216. Q. Never took a vacation in four years?

A. I never laid off, no, sir.

X217. Q. Didn't take a vacation all the year round?

A. No, sir.

X218. Q. Never once in four years?

A. Not that I remember of; no, sir.

X219. Q. You said that there were times when you might have been away for a half day. Who compounded the mixtures while you were away?

A. I did.

X220. Q. You compounded them all?

A. I would put them up before I left.

X221. Q. Laid up a sufficient supply?

A. Yes, sir.

X222. Q. There wasn't anybody else in the plant that could do it?

A. That could do it?

X223. Q. Yes.

A. There was a man in the plant that could, but he never did.

X224. Q. Who broke down the rubber?

A. You mean, when they were mixing the batches?

X225. Q. Preparatory to mixing the batches, rubber had to be broken down, didn't it?

A. We don't break it down; no, sir.

X226. Q. Who did that?

A. We tore it apart in the compound room.

X227. Q. Who is "we?"

A. Well, I did it, but in case I got real busy I might get a man or two to come in for a half hour or so off the calender, or any extra man they had, to help tear a little bit of rubber apart.

X228. Q. Who were some of the men that tore down the rubber?

A. Well, I can't recall their names. There was a man that helped on the calender—I know there was a man by the name of Sayer that worked there, and he possibly would come in once in a while to help tear it apart.

By Mr. Wooster:

X229. Q. Was rosin oil regarded as an ingredient of the stock formula?

A. I would say that it was not.

X230. Q. It was a softener, wasn't it?

A. Yes, sir.

X231. Q. Used by the mill man to soften up the batch?

A. Yes.

X232. Q. So that the mill man would be the man that would call for it?

A. Yes, sir.

X233. Q. Not necessarily in the compound room?

A. Not necessarily, no, sir.

MUNROE H. DANIELS, recalled, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

172. Q. Did you hear the testimony of Mr. Bridgewater yesterday as to the X-book tests?

A. I did.

173. Q. Do you agree with his conclusions?

A. I do not. I can state that the way the tests appealed to me at the time—the way they look in the X-book show, according to the method that we had of evaluating stocks at the Republic in 1918 and 1919, that D. P. G. had a decided value in that shoddy stock which T. P. G. did not have, and it shortened the cure. At that time we were looking for something to get better results with our shoddies, and the difference in tensile which resulted, while not a great deal in pounds, amounts to a great deal figured on stock like the shoddy stock. We use shoddies in specification work where we have to reach a certain tensile, and a few pounds less than that tensile would mean the rejection of a considerable quantity of material.

174. Q. Will you look at X-book test 2005-G-H, X-2006-H, and state whether or not those tests are comparable.

A. Yes, they are comparable.

175. Q. Will you please compare them and state your understanding of what they show?

A. The 2005-G stock, with 3 per cent of T. P. G. has fifteen minute less cure, fifteen minute shorter cure, than the "H" stock; and while the tensile is quite a bit lower, the time is considerably lower. The 2006-H, having 2 per cent of diphenylguanidine, which is less accelerator in quantity—than 3 per cent of triphenylguanidine, has five minutes less cure, five pounds less steam, and a little less than 200 pounds greater tensile. That to me was very significant, in view of the fact that our shoddy stocks never showed very much snap in the ordinary compounding.

176. Q. Now, will you take X-book test—2059-D-E, 2039 blank, X-2039-A-C, and X-2067-E, and state whether or not those tests furnish basis for any conclusion as to relative actions of D. P. G. and T. P. G. in the stocks named?

A. Yes.

177. Q. Will you make the comparison?

A. They show, in general, that D. P. G. cut the time of cure over T. P. G.

By Mr. Edmonds:

178. Q. Which ones do you say show that?

A. 2039-H.

179. Q. 2039-H and what else?

By Mr. Wooster:

2039-A-C, 2039 blank, 2059-D-E, and 2067-E.

By Mr. Wooster:

180. Q. Referring to the defendant's exhibit, Stephens' letter, Exhibit "F,"—National Record, page 540—will you explain how that letter came to be written, including the footnote in handwriting?

A. Mr. Stephens was in New York and had given me a report on the sort of work he was doing. This involved considerable expense, especially the photostats that he was taking, and I considered we had enough information on T. P. G., and I wanted to get what he could find on D. P. G., so that the purpose of the letter was first, to tell him to shorten his work, and emphasize the fact that I wanted some information on D. P. G.

181. Q. What was the relation, if any, between your reference to diphenyl, in this letter of December 1, 1919, and your trip to the Chemical Society meeting at Philadelphia, between the preceding September 2 to 6?

A. There was no direct relation. I had gotten enough information from Weiss to have a distinct idea of going ahead and planning for the manufacture of D. P. G., and I wanted to inform Stephens he would have the job of either erecting a plant or changing the T. P. G. plant over to that effect.

CROSS-EXAMINATION.

By Mr. Edmonds:

X182. Q. You made some reference to page X-2039 of the 2000 X-book, columns blank, A and C, where tests with triphenylguanidine are recorded Those tests showed pretty good results, didn't they?

A. Yes, those are good results.

X183. Q. Very good, aren't they? For instance, in Column C, the tensile strength is 3230—pretty good, isn't it?

A. Yes.

X184. Q. Now, look back at the test that you referred to on X-2005, column G. You will note down at the bottom there it says, "was not mixed well." There must have been something the matter with that to cause one to put that inscription on there, and if that were so, wouldn't you think that would be a rather unsafe basis for comparison?

A. Well, that might refer to anything—I mean, it would not be a specific cause for rejection.

X185. Q. It might refer to anything?

A. (Witness does not answer).

C. A. CARLTON, recalled in rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

51. Q. Will you state again when you entered the employ of the Republic Rubber Company?

A. June, 1917—that is, the first week in June.

52. Q. What did you do after you got there?

A. Well, I was hired specifically to do work on organic compounds, that is, accelerators.

53. Q. In order to commence that work, did you look over the records which you found there?

A. I did.

54. Q. Did you look at the 2000 X-book?

A. Yes, sir.

55. Q. How closely did you examine that book?

A. Very thoroughly, because it is my—or was my position, to continue whatever research work had been done on organic accelerators, and naturally I wanted to know what had been done previous to my going to the company.

56. Q. To the best of your recollection, when did you make this detailed examination of the 2000 X-book, relatively to when you went there?

A. Oh, very shortly after I entered the employ of the company.

57. Q. Within three or four months?

A. Oh, no—probably within the first week.

58. Q. Did you make any notes from this X-book —from these X-books—as to accelerators?

A. Not that I remember. There wasn't anything in these that I was particularly interested in.

59. Q. Was there anything in there that was new to you?

A. It had some of the exact tests, as far as showing the results—were new. If I remember rightly, all of the compounds that had been tested as accelerators were either in the literature or substances that were being used commercially at that time.

60. Q. To the best of your information and belief, state whether or not the reference "diphenylguanidine," on X-2005, in ink hand printing, appeared on that column when you first looked at that book?

By Mr. Edmonds:

I object to this question, if Your Honor please. This appears to be an effort by the plaintiff to impugn a document brought in here by plaintiff in the effort to prove its own case —in other words, they are trying to criticize their own documentary evidence. The book is brought in here by plaintiff and offered in evidence as a reliable document, presented by way of proving that Weiss did something at one time, and now they come around and say "This document is not a reliable document, and we do not want the Court to accept it." And I do not think that should be permitted. I object to the question as an obvious effort in that direction.

By Mr. Wooster:

That particular word, "diphenylguanidine," was disclaimed by Mr. Weiss at the time the record was put in, and we could not remove that handwriting from the page, but we did want the page in. The plaintiff in no way is impugning anything that it relies on or offers.

Objection overruled.

Exception noted to defendant.

A. It was not.

61. Q. What can you say as to some of the other things underneath, such as "D shoddy," "E shoddy," "C shoddy," "anhydroformaldehyde," "triphenylguanidine," and some of the others?

A. Well, answering that question, I can say that tests on hydroformaldehydeanilin and triphenylguanidine were recorded in the book. Whether or not they are on page 2005 I would not be able to state.

62. Q. Did you ever have occasion to examine this book after this first examination?

A. Certainly. This was given over to me—the book in which I recorded practically all the experiments that I carried on while at the Republic.

63. Q. Did you write that word "diphenylguanidine," on page X-2005?

A. I did not.

64. Q. What can you say as to when you last saw the book before leaving the employ of the Republic, regarding this entry?

A. You mean, when did I see the X-2000 book while in the employ of the company—is that the question?

65. Q. Have you any recollection as to when you last saw this page X-2005 before leaving the Republic?

A. Why, I probably saw it the last day I was there.

66. Q. When was that?

A. I can't state the exact date, but it was in March, 1918. If I remember rightly, it was nearer the end of March than the beginning, but I couldn't say positively. I never looked it up.

67. Q. When did this page X-2005, thereafter come to your attention?

A. Well, now, I can't say as to the exact date or whether or not it was this actual page. I had seen either the book or photostatic copies of it some time, I believe, in 1922.

68. Q. Did you ever have any discussion with Mr. Barrows respecting this page X-2005?

A. I don't know as I could answer that question with respect to this particular page. I did have discussion with regard to the word "diphenylguanidine" being in the X-book dated in 1917, I think it is.

69. Q. What was the occasion for the discussion?

A. Mr. Barrows came to see me at Mansfield, in connection with the case. He wrote me a letter relative to some missing pages, in this letter asking me if I could give him the address of Mr. Baldwin—I think he was trying to get in touch with Mr. Baldwin at that time—and in this letter he mentioned the fact that they had found these missing pages, and in his letter he made the statement that they had

found work evidently done by Mr. Baldwin recorded on these missing pages, and asked me what I knew about the case. Then I don't know whether he had been to see me before or after that—I can't state exactly as to that; but I remember we had a discussion at that time in regard to this word "diphenylguanidine," and I said, to the best of my knowledge and belief it was not in the book at the time I was at the Republic.

70. Q. You told Mr. Barrows this in 1922?

A. Yes, sir.

71 Q. Referring to the word "diphenylguanidine," on page X-2005, were you familiar with that word before you went with the Republic?

A. I don't believe so; that is, I don't believe that I had noticed diphenylguanidine in the literature. Of course, I knew there was such a substance possible, but I was not familiar with it.

72. Q. Where are you now employed?

A. Columbia Tire & Rubber Company, Mansfield, Ohio.

73. Q. Is T. P. G. used by this company in its commercial product?

By Mr. Edmonds:

What is the use of that? Is that rebuttal of anything?

By Mr. Wooster:

It certainly is.

By Mr. Edmonds:

Columbia Tire & Rubber Company—has that ever been mentioned?

By the Court:

What does this rebut?

By Mr. Wooster:

That is rebuttal of defendant's proposition that there is no utility of D. P. G. over T. P. G., concerning which the defendant used several days here, calling Mr. Bridgewater and other witnesses. It seems competent for plaintiff to show by other witnesses in rebuttal its ideas of the relative status of T. P. G. and D. P. G. in the practical art. Mr. Bridgewater gave some figures showing the total consumption of T. P. G. in the year 1924, and the plaintiff proposes to show the consumption of D. P. G. in that and other years, and also T. P. G. It is for the purpose of comparison.

By Mr. Edmonds:

This question is, does some company use something? I can't see that is rebuttal of anything.

By the Court:

Well, it is preliminary to the other, you say, by showing his knowledge of the use. Go ahead for the present.

A. It is not.

74. Q. Is D. P. G. used by your company in its commercial product?

A. Yes.

75. Q. Do you have anything to say as to what is or is not used as an accelerator in the product of your company?

A. Do you mean, do I decide that?

76. Q. Yes.

A. Yes.

77. Q. Did you make the decision to use D. P. G. rather than T. P. G.?

A. Yes.

78. Q. Will you state the reasons why you did that?

A. T. P. G. could not produce the results that I desired in the time in which we cured our compounds to anywheres near compete with D. P. G., as far as cost is concerned.

79. Q. What are the prices of D. P. G. and T. P. G.?

A. D. P. G. at the present time, average price is 95 cents a pound. T. P. G., I am not so familiar with the price at the present time. I would say that it is probably around 70 or 75 cents a pound.

80. Q. Why then would not T. P. G. be cheaper as an accelerator than D. P. G.?

A. Well, in the first place, even if the time of cure were such that you could produce it with T. P. G., it would take several times as much T. P. G. as D. P. G., so the final accelerator cost would be very much greater.

81. Q. In the testimony yesterday of Mr. Sanderson, it appeared that one part of D. P. G. was compared with eight parts of T. P. G. At that rate, would not 95 cents worth of D. P. G. be worth at least as much as several dollars' worth of T. P. G.?

A. It certainly would, in that compound.

CROSS-EXAMINATION.

By Mr. Edmonds:

X82. Q. Now, going back to this X-book, page 2005, I understand you to say that this word "diphenylguanidine" in the column at the left, was not there, but that these other entries, "D shoddy," "Z shoddy," "C shoddy" and then some long chemical name, and then some name "triphenylguanidine," were there?

A. No, that was not my answer. I said that to the best of my knowledge, "diphenylguanidine" was not in the book, that other substance, "hydroformaldehydeanilin" and "triphenylguanidine," and so forth, were in the book. I did not say that "C shoddy" or "D shoddy" were there or were not there. Neither did I say they were in this particular page.

X83. Q. Then you don't know anything about this page and the condition of this page when you went with the rubber company?

A. I made the statement. And my answer to that question is, that it was not in the book.

X84. Q. This page was not in the book?

A. No—Pardon me. The word "diphenylguanidine" was not in the book at the time I was at the Republic.

X85. Q. Was this inscription at the top, "Action of Organic Accel.," was that there?

A. I believe so. It was filled out—at least, it is not in my handwriting.

X86. Q. You think it was there?

A. I believe that was.

X87. Q. Under that is written "on shoddies" —was that there?

A. I couldn't say as to that. I know a good many of the headings were already filled in by others previous to my time.

X88. Q. You don't know whether "triphenylguanidine" was on there or not?

A. It was in the book. I wouldn't say it was on page X-2005, but it was in the book.

X89. Q. Was this other word—"hydro"—something?

A. "Hydroformaldehydeanilin"; yes, it was in the book.

X90. Q. You don't know where it was?

A. Not on what page, but I know it was in the book—in the early part of the book—because when I came there, if I remember rightly, it was only about the first eight or ten pages contained any information whatever about accelerators.

X91. Q. You think this inscription "on shoddies" was on there at the time?

A. I couldn't say, I have no idea.

X92. Q. Do you know anything about this entry, "X-2004-C," whether that was there?

A. I couldn't say as to that or not. All I remember about the entries in the book, as I said, were the actual organic compounds that were listed as accelerators, because that was what I was interested in and made a note of in my mind; because there wasn't anything in there at the time but what I knew of, either from the literature or my own personal experience.

X93. Q. Well, where was the entry of "triphenylguanidine" in the book?

A. I couldn't say as to what page. As I explained in my previous answers, it was in the first few pages of the book. It had been tried as an accelerator.

X94. Q. Triphenylguanidine had been tried as an accelerator and was entered in the book?

A. I believe so, to the best of my knowledge.

X95. Q. Well, is that a thing that you can be sure of, or is this just something you are stating on the basis of a recollection more or less distinct?

A. I know of triphenylguanidine, I know we used it while I was at the Republic, and tried it. I am not certain as to whether triphenylguanidine was a commercial product at that time or not. I was familiar with its preparation and use before I came with the Republic.

X96. Q. And you don't know whether it was entered in this book or not?

A. You mean, at the time I came?

X97. Q. At any time while you were there.

A. Why, yes, of course it was entered while I was there.

X98. Q. Well, was it entered when you got there—Let us limit the question about this. You said you examined the book before you started to make entries in it?

A. Yes.

X99. Q. Was it there when you examined the book?

A. I believe it was. I would not swear as to that.

X100. Q. What about this "anhydroformaldehyde," was that in the book?

A. Yes, sir.

X101. Q. That was in the book at the time you examined it, before you started to make entries?

A. Yes, sir.

X102. Q. Do you remember that distinctly?

A. Not distinctly—just that particular compound. Only by the fact that that was a well-known compound and had been used, and those entries are in Mr. Baldwin's handwriting, and were in there.

X103. Q. What about paraphenylenediamine—was that in the book?

A. It was.

X104. Q. At the time you examined it before putting any of your entries in it?

A. Yes, sir.

X105. Q. Now, will you look at the book and show us an entry of paraphenylenediamine that was in the book at the time you went there?

A. I see here is a substance marked "phenylenediamine," but there is no designation in front of it as to "para," but paraphenylenediamine was known in the art at that time, and would be the only phenylenediamine that you would imagine would be in there.

X106. Q. Now, look in the book and see if you find any entry of "triphenylguanidine?"

A. There is an entry, but I don't believe that was in my time—No, I guess that is all.

X107. Q. You don't find any?

A. No, I do not. I was not positive of "triphenylguanidine," as I stated before.

X108. Q. In this controversy over this Weiss patent, you have appeared at various times on both sides, haven't you?

A. Not that I remember appearing on both sides—just what do you mean by that?

X109. Q. In the course of the case in the Aniline suit, you gave affidavits on both sides, didn't you?

A. Oh, yes.

X110. Q. And in one of them you said you had talked with Mr. Weiss, and your recollection had been refreshed by your talk with him?

A. I don't remember of the exact contents of those.

X111. Q. You do recall that in substance, don't you?

A. I don't know as my mind was necessarily refreshed. I remember at the time the affidavit was first given the National Aniline, I knew absolutely nothing about the case except that a patent had been granted to Weiss—a representative of the National Aniline came to Kelly-Springfield Tire Company, and in talking with Mr. Peterson, got in touch with me, and, if I remember rightly, at that time he wanted to know if I could make any statement that would throw any light on the subject.

X112. Q. And at his request, you signed an affidavit?

By Mr. Wooster:

I object to this as outside the direct examination. This witness was only examined in regard to the entry in the X-book relating to diphenlyguanidine.

By the Court:

I think at any time, and in such case, when a witness is on the stand and has given any testimony, he can be cross-examined as to his credibility—that is, as to matters which may affect his credibility.

Objection overruled.

Exception noted to plaintiff.

(Question read).

A. Yes.

X113. Q. Then a short time after that an attorney, Mr. Barrows, representing the National Aniline Company, came and talked with you at Mansfield, Ohio?

A. I remember it was not a short time; it was quite some time. I don't remember the exact dates in either case.

X114. Q. Well, it was two months, to be exact.

A. I don't remember as to the time.

X115. Q. You understood in your talk with Mr. Barrows that he represented the National Aniline?

A. Positively.

X116. Q. And that in your talk with him you discussed this affidavit that you had made down at Cumberland?

A. I don't remember whether we discussed that particular affidavit or not. I guess we did.

X117. Q. You recall that in that interview with Mr. Barrows, you told him quite definitely that Mr. Weiss was not the inventor of diphenylguanidine?

A. I don't believe I made such a statement as that.

X118. Q. You also told Mr. Barrows where he could find other people who would corroborate your statement to that effect, didn't you?

A. I don't remember as Mr. Barrows and I had any particular discussion as to that point. I don't remember exactly.

X119. Q. Do you recall telling Mr. Barrows the name of some one that he could go to, who would corroborate all that you had said?

A. If I remember rightly, the situation was this: Mr. Barrows asked me if there were any other men in the Republic organization at the time Weiss was there, and myself, that he could get in touch with, and I did give him the name of—I think it gave him the name of Mr. Santon, who worked under me at that time.

X120. Q. Your present testimony is that that was purely general as to what other employees were there?

A. What do you mean by that?

X121. Q. Your reference to Mr. Santon—you merely refer to him as one who worked for the Republic, who could tell about conditions at Republic?

A. Well, at that time there weren't very many of us in the laboratory. I didn't have very many left to refer to.

X122. Q. The point I make is this: It is your

testimony now that you did not say that Weiss was not the inventor of diphenylguanidine, and that Santon would corroborate you in that fact? Is that correct?

A. I don't believe I made the statement in those terms. I certainly did not mean to convey that idea. Anything that I have said has been as near the truth as I know how to put it.

X123. Q. Then in the next month, in September, 1922, you saw Mr. Weiss in Pittsburgh?

A. Yes.

X124. Q. And shortly after that—the next month—you and Mr. Barrows met again at the hotel in Mansfield. Do you recall that?

A. What day was that?

X125. Q. October 8, 1922.

A. I have forgotten whether Mr. Barrows was at Mansfield more than once or not. If he was—I know I met him there once, I couldn't say the date.

X126. Q. Don't you recall that you had an interview with him, in which you said that you could not attend the trial, that your company would not permit you to attend the trial of the National Aniline suit?

A. I know we had—I talked to Mr. Barrows at Mansfield, I don't know as I ever made any statement that the company would not permit me to attend.

X127. Q. You have no recollection of that?

A. No, I have not.

X128. Q. Do you have any recollection of saying that you regretted signing the original affidavit that you signed down in Cumberland?

A. No, I don't know as I did.

X129. Q. Following that, you did appear at the trial of the National Aniline suit, and testified for the plaintiff?

A. Yes, sir.

X130. Q. And following that, you took a job with the Dovan Company?

A. Yes, sir.

X131. Q. I show you a document and ask you if this does not refresh your recollection that in an affidavit which you signed you stated: "The above facts were recalled to my mind by a conversation with Mr. Morris L. Weiss at the time of the meeting of the American Chemical Society in Pittsburgh, Pennsylvania, during the first week of September, 1922."

A. That is true. I would like, if permitted, to make just a slight explanation.

X132. Q. That is all that you were asked, so we will drop the matter there.

By the Court:

(To witness): You may make that later, if counsel for plaintiff desires to have it.

X133. Q. This document that I now hand you is the original of your first affidavit?

A. Yes.

By Mr. Edmonds:

I offer the paper just identified by the witness in evidence as Defendant's Exhibit "WW."

By Mr. Wooster:

Objected to as immaterial and incompetent.

Objection overruled.

Exception noted to defendant.

REDIRECT EXAMINATION.

By Mr. Wooster:

134. Q. What was the explanation which you wanted to make of one of your answers, and which was not permitted?

A. Why, I wanted to explain the position of myself in this matter. My first affidavit was given more or less at Mr. Peter's request that if I did know anything about the case, I should give it. I had forgotten entirely about it, I didn't want to get mixed up in it, I didn't want to appear for either side, because I was neutral at that time and am now. On meeting Mr. Weiss at the meeting of the American Chemical Society, he asked me if I would spend a little time with him and talk over the situation. He called to my attention—or asked me if I remembered the time that he brought the book Richter—organic chemistry book—to me and pointed out diphenylguanidine. That is exactly the case, and those statements are made in the affidavit, and to Mr. Weiss. At that time I had no idea of appearing as a witness for either side, and as I say again, the statements that are made in both affidavits are absolutely true, to the best of my knowledge, but my memory as regards that particular incident of having had Mr. Weiss call my attention to the word "D. P. G." in the book is absolutely the facts in the case.

135. Q. Did Mr. Barrows ever ask you to make an affidavit or testify that "diphenylguanidine" did appear in the X-book, when you first saw it?

A. I don't know as he did ask me right out to give an affidavit that it appeared. I wouldn't say that he did.

136. Q. Did you have any words with Mr. Barrows at any time?

A. You mean, in regard to this entry?

137 Q. Yes.

A. Yes. I don't know whether Mr. Barrows had the X-book or photostatic copies at the time he called on me in Mansfield, but we went over the X-book, as I remember, practically page by page, and I was pointing out the entries in that book that I remembered as being there when I was with the company, and I remember when we came to this page with "diphenylguanidine" marked on it, I looked at it, and of course first looked at the date, and the date entry was some time in 1917—or at least it was during the time of my employment with the Republic, and I stated to him at that time that to the best of my knowledge, the word "diphenylguanidine" was not in the book.

By Mr. Wooster:

To complete the record, I will offer as Plaintiff's Exhibit 14, affidavit of Mr. Carlton, in *Dovan vs. National*, verified November 7, 1922, this being the affidavit which was just shown him in cross-examination.

A. H. NELLEN, recalled in rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

30. Q. When you went with the Republic, did you have anything to do with X-book 2000?

A. Not directly.

31. Q. Did you have anything to do with any of the X-books?

A. Yes, I had my own.

32. Q. Did you ever look at X-book 2000?

A. Yes, I did.

33. Q. When?

A. Well, I looked at it in 1917, when I was there first, and I also had a number of occasions to look at it during 1922, and subsequently.

34. Q. Is that the book here before you, which has heretofore been referred to?

A. Yes.

35. Q. What was the occasion for your looking at it in 1917?

A. Why, just in rather a casual manner, being in the office there, and while I did not make any entries in it, nevertheless I often looked at the formulas in it which we used for testing different materials.

36. Q. At that time did you see the word "diphenylguanidine" in it, that you remember?

A. I don't remember at that time whether I saw it or not.

37. Q. Did you after 1917 leave the Republic?

A. Yes.

38. Q. When was that?

A. On the first of February, 1919.

39. Q. And then you came back again?

A. Then I came back again after the war. Then I left again and came back again.

40. Q. During the second time you were with the Republic, did you see the word "diphenylguanidine" in this X-book?

A. No, I didn't have access to this book during that period of employment at all.

41. Q. Give me dates between which you were there for the third time?

A. Why, from the first of March, 1922, up to the present. Of course, the company is now owned by the Lee, and I am with the Lee Tire now.

42. Q. You went over with the Republic to Lee at the time Lee took over the Republic?

A. Well, I was transferred from the Republic factory to the Lee factory after the Lee Company bought the Republic.

43. Q. Did you see this X-book in 1922?

A. I did.

44. Q. What was the occasion for your looking at it then?

A. Well, I went back to the Republic in March, 1922, and shortly after that time, I believe, this patent was granted, and naturally it caused quite a bit of comment in their laboratory force. It happened that Eaton at that time had this book in his desk, and his desk and mine happened to be right next

to each other, and we were naturally friendly and talked together quite a bit, and we went over this book, and he showed me the book, and on one particular day I remember going through it quite thoroughly, to see if we could find out anything about the matter—just as a matter of curiosity, never thinking I would use the information again, but I did go through it very thoroughly, and I looked down along that lefthand column to find D. P. G. entries.

45. Q. Which pages did you look at?

A. Well, I looked all through the book.

46. Q. Do you recall any that you found in March, 1922, when you looked at this book?

A. I found a large number of entries of "diphenylguanidine," "diffendoe," "diphen," and so on.

47. Q. What is your recollection as to what you found on page X-2005?

A. To my recollection, that "diphenylguanidine" was not printed there at that time.

48. Q. How good is your recollection as to that?

A. I think it is very good.

49. Q. Did you thereafter see the X-book, and particularly this page?

A. I have been seeing it continuously from then until now. I have had it in my custody most of the time.

50. Q. Did you have occasion to look at this page X-2005 later than about March, 1922?

A. Well, after that time that I looked at it, which was some time in March or April of 1922,

it was out of the book some time. Then when it came back again, it had this on it.

CROSS EXAMINATION.

By Mr. Edmonds:

X51. Q. Where were you employed in January, February and March of 1920?

A. Firestone Tire & Rubber Company.

X52. Q. Do you recall that Mr. Weiss applied for employment there?

A. I do.

X53. Q. And he did not get it?

A. No, sir.

X54. Q. Did you have anything to do with that?

A. Nothing, except I happened to be the only friend of Mr. Weiss's who happened to be working at the Firestone, and I just happened to act as intermediary between him and Doc. Shepard, I just introduced him, that is all.

X55. Q. That is all, in connection with that incident?

A. That is all.

X56. Q. You are quite sure of that?

A. Positive.

VAN LEAR WOODWARD, recalled on behalf of plaintiff in rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

91. Q. Mr. Woodward, did you ever examine the 2000 X-book?

A. I have.

92. Q. When?

A. The first time on May 11, 1922.

93. Q. What was the reason for that examination?

A. I went out accompanied by our attorney, Mr. Vaill, to investigate at the Republic Rubber Company's office the work that had been done by Mr. Weiss while he was employed by that company.

94. Q. What were you looking for?

A. We were looking to find out just exactly what he had done in connection with diphenylguanidine?

95. Q. What pages in the 2000 X-book did you examine?

A. I examined every page in the book.

96. Q. Is this the book (referring to 2000 X-book)?

A. Yes, this is the book.

97. Q. Were the pages there in consecutive order at that time?

A. Well, you can hardly call them consecutive order, because some had a number here (indicating), and the next number there, and some had blanks;

but so far as the numbers were concerned, they were consecutive.

98. Q. Well, was the book complete?

A. The book was complete, to the best of my knowledge.

99. Q. Do you recall anything particular that you observed about X-2005?

A. I do.

100. Q. 2006?

A. I do.

101. Q. Will you state what it is?

A. On page 2006, column H, there is a reference comparing that test, which contained diphenylguanidine, with page 2005, column H. I made that comparison, and noted that it was a comparison with the same compound, containing lime, and that right next to it, in column G, was a comparison with a compound exactly the same, excepting that it contained triphenylguanidine. In that I was very much interested, as at one time I had considered the manufacture of triphenylguanidine and had given it up, and this confirmed my opinion.

102. Q. Is that the only thing on page 2005 that you looked at?

A. I looked at everything there was on the page. My purpose was to find every entry of diphenylguanidine.

103. Q. There is an entry in hand ink printing, "diphenylguanidine." Now, on X-2005, the first column. What is your recollection as to whether or not that entry was there when you looked at this book?

A. That was not there.

104. Q. Are you positive of that?

A. Very positive.

105. Q. Did you see this book later?

A. I saw it on June 7, 1922.

106. Q. What was the occasion of seeing it then?

A. About a week, possibly, before that, Mr. Stephens, formerly an employee of the Republic Rubber Company, came to my office, and during a conversation told me that this Republic Rubber Company X-book had been brought to New York by an employee of the Republic Rubber Company, by name Mr. Eaton—

107. Q. Don't give hearsay, please.

A. I am not. This is what he told me. —and that he had attended a meeting at the National Aniline office, and that this book had been photostated from page to page, and he thought we would be interested in knowing it. I was making a trip to Akron in connection with this case, with Mr. Vaill, and on our way back to New York, we stopped off at Youngstown and made another visit to the plant. We made that visit—it was in Mr. Zieme's office in the laboratory, and I asked him why he had permitted the book to go out of his possession when at the first time I met him in this matter he said that both sides had had access to it, but that it couldn't go out. I then examined the book with Mr. Vaill, as we wanted to again go over some matters, some of the tests, dates and things, and to our surprise we very shortly found that this page 2005 was missing, because we endeavored to do the same

check-up that we had successfully done the first time, and it wasn't there. We then found that 2008 was missing at the same time.

108. Q. When did you next see the X-book?

A. I next saw the X-book in the latter part of December, 1922, at the New York office of the Republic Rubber Company.

109. Q. In what condition was it then?

A. It was entirely surrounded by books, with a glass over it, so that nobody could touch it.

110. Q. Was it complete or incomplete?

A. This page 2005 was back.

By Mr. Edmonds:

111. Q. What date was that?

A. It was the latter part of December, 1922.

By Mr. Wooster:

112. Q. Just before the trial of the Aniline Case?

A. Yes.

113. Q. Did you examine this page X-2005 then?

A. Did I examine it?

114. Q. Yes.

A. I certainly did.

115. Q. What was on it then?

A. This word in printing "diphenylguanidine" was on the page.

116. Q. Otherwise, how did it compare with the page as you had previously seen?

A. It had the figure "1" right alongside the "diphenylguanidine," and I think this total was put it, which had not been in before, this total "101.00." I don't recall any other change.

117. Q. Have you census reports for 1923 and 1924, showing statistics relating to synthetic and other organic chemicals?

A. Yes; we received them.

118. Q. Do these reports contain any references to sales of diphenylguanidine and triphenylguanidine?

A. They do.

119. Q. Will you point them out?

A. In the 1923 report, on page 28, it shows figures from six manufacturers showing sales during the year of 846,431 pounds of diphenylguanidine; on page 31, it lists triphenylguanidine and gives two manufacturers but no figures regarding sales or production. The 1924 report, on page 32, shows four manufacturers of diphenylguanidine, sales, 1,018,609 pounds; on page 35, it shows five manufacturers of triphenylguanidine, and sales of 340,829 pounds.

120. Q. If one part of diphenylguanidine replaces eight parts of triphenylguanidine, or vice versa, what is the ratio—approxmiate ratio—between the amounts of rubber respectively cured by diphenylguanidine and triphenylguanidine, assuming that the figures there reported went into rubber?

A. Will you ask that question again? You said something there about vice versa that threw me off.

121. Q. Well, take it either way. (Question read).

A. Approximately, on that ratio, 40,000 pounds of diphenylguanidine would accomplish the results claimed by 340,000 pounds of triphenylguanidine.

By the Court:

How do you make that out? Eight and one, wouldn't be 320?

By the Witness:

I said approximately, sir. I do not have the exact figures.

CROSS-EXAMINATION

By Mr. Edmonds:

X122. Q. Will you answer yes or no to this question? It is your testimony, as I understand it, that at that date in April when you saw this X-book, this word "diphenylguanidine" was not in the book, because if page 2005 had been missing from the book, you would have noticed that it was missing, and therefore it must have been present, and if it was present, and "diphenylguanidine" had been on it, you would have seen the "diphenylguanidine" on it?

A. I didn't see the book in April—you said "that date in April."

X123. Q. I said the month wrong. I meant May. Will you answer that question yes or no, with reference to May, 1922?

(Question read).

A. That sounds as though it had a couple of cross-purposes with it.

X124. Q. You may have it read again. It is a perfectly simple and direct question and I would like to have a direct answer.

A. I will answer that the page was not there at the time I saw it—I mean, that the page was there at the time I saw it in May, 1922.

X125. Q. Will you have the question read to you again, and see if you can answer it yes or no.

(Question again read).

A. I may be stupid, Your Honor, but that sounds to me like a double question.

By the Court:

X126. Q. If you can't answer that yes or no, say so?

A. I can't answer that yes or no.

By the Court:

It would be pretty difficult to follow it, Mr. Edmonds. I confess, it takes in a good many things.

By Mr. Edmonds:

I will take it step by step. I thought I could get it by one question.

By Mr. Edmonds:

X127. Q. The testimony that has been produced here is that on that day when you saw that book, that page 2005 was not in it. Now, I understand it is your testimony that the page was in, because, if it had not been there you would have noticed its absence?

A. Correct.

Q128. Q. That is correct. And I also understand you to say that the word "diphenylguanidine" was not on that page, because, had the page been there and the "diphenylguanidine" on it, you would have seen the "diphenylguanidine"?

A. Correct.

X129. Q. One further question I wanted to ask you is this: You are the individual, are you not, who was shown in this interference record to have sent your representative to see a witness called by your opponent, to try to tell him how to testify, are you not?

By Mr. Wooster:

I object to that. It is totally outside the direct examination, and not a correct statement of fact, anyway.

By the Court:

I don't see how it is proper cross-examination, Mr. Edmonds.

By Mr. Edmonds:

It relates only to his credibility. I don't believe the witness's testimony, and I think that this matter detracts from his credibility to such extent that it would not stand here.

By the Court:

You mean, the present witness or the other witness?

By Mr. Edmonds:

The present witness.

By the Court:

The fact he sent an agent to interview—

By Mr. Edmonds:

A witness called by his adversary, after he had had notice that the witness was to be called —to suggest to him that they would like to have the testimony so-and-so.

By the Court:

Well, that takes in a good many things. An interview of that kind might be perfectly proper, and the agent might have taken improper means. I don't think you can examine him on that.

By Mr. Edmonds:

I will withdraw the question, and, instead, will note on the record reference to pages 274, 275 and 276 of this Interference, where all of the details are set forth with great precision. That book is in evidence and reference can be made to it.

By Mr. Wooster:

I offer in evidence, as Plaintiff's Exhibits Nos. 15 and 16, respectively, the report of the Tariff Commission for 1923, No. 32, this being Plaintiff's Exhibit No. 15, and a similar report for 1924, No. 33, being Plaintiff's Exhibit No. 16.

CARL S. WILLIAMS, a witness produced on behalf of plaintiff in rebuttal, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

1. Q. What is your name, age, residence and occupation?

A. My name was just given; age, thirty-nine; residence, Woodbridge, N. J.; occupation, I am director of our Rubber Service Department—that is, the Roessler and Hasslacher Chemical Company.

2. Q. How long have you been director of this Rubber Service Department?

A. Since its establishment in 1917.

3. Q. What is the function of this rubber service department?

A. The investigation of accelerators of our own make, our competitors', the development of new accelerators, is the principal purpose—and of being of service to our customers in doing service work.

4. Q. Are you able to prepare chemical compounds and cure and test rubber and make comparisons?

A. That is one of the functions of my department.

5. Q. Will you state what your education has been in chemistry and in rubber work?

A. I graduated from the Ohio State University with a degree in chemistry, and directly from that—which was in 1913, I believe—I went with the U. S. Rubber Company, at their laboratory, general laboratory in New York, where I received a diversified training in rubber, covering tires and mechanicals, and boots and shoes, beltings, and I might say all types of rubber stocks. I spent part of my time at the different factories, to inspect the processes and get acquainted with the methods in use at that time. I was there something under three years—I don't remember the exact length of time—and then went into the employ of what was then the Perth Amboy Chemical Works, as a research chemist. They were making accelerators for the rubber trade, and there was a growing interest in accelerators, and it was my duty to keep abreast of the times and to develop new ma-

terials as I could, and to test them out. The actual laboratory, rubber laboratory itself, was established several years later—the date I gave before, as we felt the need of that laboratory for trying out our materials. I might add that we have tested many hundreds of new materials of various types. We have had a corps of a number of the best chemists we could employ for organic preparation work, and we still have such a corps. We have made series tests on all the common commercial accelerators, to determine their behavior with varying percentages of the accelerators with a combination of various percentages of sulphur, in the presence of zinc oxide and magnesium oxide—each one of these, you understand, is a series, not a single test; a series involves perhaps several hundred tests—carbon blacks, mineral rubbers, hard rubber stocks, soft rubber stocks. We make it as complete as we possibly can for evaluating the accelerator.

6. Q. Is it one of the functions of this rubber service department to aid rubber manufacturers and compounders as far as possible in the improvement of rubber?

A. Yes. Right from the start, that was one of the objects as set forth for the establishment of the laboratory. That was one of the principal reasons we established that—to give that service to our customers, and help them adopt our materials to their formulas, and I think we have been highly successful, as we have many clients taking advantage of that service.

7. Q. In this laboratory, what kind of equipment do you maintain for testing?

A. Well, we have the usual laboratory, mills and calendars and vulcanizing presses, and open heaters—what we call the open box heater, where the rubber is cured in just hot air—and then we have testing units to determine the physical properties of the rubber, among which we have recently developed a method of getting the stress-strain relation, which I consider one of the most important tests that you can submit a rubber sample to, showing the load necessary to give you a certain elongation.

8. Q. Within your experience, has any progress been made in the years since, say, the beginning of 1919, in the investigation of the problems of rubber?

A. Oh, yes; there has been considerable development. I think there have been numerous papers published showing developments. I believe Ira Williams has brought forth one development on plasticity. I might be mistaken on the author of that particular test.

9. Q. Are the tests to which rubber is put today more or less scientific and accurate than were available in 1919?

A. They are somewhat more accurate. There has been some good operative machines developed, which they did not have at that time, and, as I say, stress-strain machines have been developed, which they did not have at that time. They did have the ordinary type of Scott, Riehle & Olsen testing machines, that stretches the rubber until it breaks.

10. Q. I mean, today the testing of rubber is a more accurate and scientific determination than it was in 1919, is it not?

A. Oh, yes, indeed.

By Mr. Edmonds:

Is this qualification or rebuttal?

By Mr. Wooster:

This is still qualification.

11. Q. Did you attend the meeting of the American Chemical Society in Philadelphia in 1919?

A. I did.

12. Q. Did you make a report?

A. Yes, sir; I made a report to my company as soon as I got back.

13. Q. Will you produce that report?

Objected to as not rebuttal.

Objection overruled.

Exception noted to defendant.

A. I produce the report.

14. Q. Where has this report been since you made it?

A. It has been in the files of the Perth Amboy Chemical Works, at Perth Amboy.

By Mr. Wooster:

The witness produces report dated September 8, 1919, which is offered in evidence as Plaintiff's Exhibit No. 17.

Objected to as not rebuttal.

(Objection withdrawn.)

15. Q. Did this paper, as read by Dr. Kratz, afterwards come out in print?

A. Yes; it was subsequently printed in the technical journals.

16. Q. That is the paper that was published in April, 1920?

A. I believe that is the date.

17. Q. Was that paper as published identical with the lecture as given?

A. No, it was not. As I point out in that report, I mention that we were especially interested in that paper, in view of the fact that it explained the reaction of hexamethylenetetramine during the process of vulcanization. The statement was made, and a formula drawn on the blackboard, that this material broke down into thiourea, which is a sulphur compound, and I believe he stated that that was the true accelerator. That statement does not appear in the printed paper at all, and that was the one thing that interested me more than anything else in that paper.

11. Q. Did you see tables 1 and 2 of this paper, as published in April, 1920, Defendant's Exhibit "E." and put on the blackboard?

A. That is the table that was put on the blackboard.

19. Q. Tables 1 and 2?

A. Tables 1 and 2; yes. I believe they were both put on the blackboard.

20. Q. Was there any standard method of comparing accelerators in 1919?

A. There was a standard method which we used at the United States Rubber Company, which consisted in subjecting them to a series of tests somewhat similar to what I base my subsequent work on, and they were put on testing machines, to get the

tensile strength—actual tensile in pounds per square inch.

21. Q. Was that the same method as was followed in arriving at Table 1?

A. I saw no figures showing the relative tensile strength of the materials in Table 1. Whether there ever were any made, I don't know, but there was surely none presented in the paper. As I understand, they were made by what was then called "tooth-and-thumb" method—a method which I have never used, however, so I cannot judge of the accuracy of tests conducted in that manner—although I would hate to use that and make recommendations to my customers based on any such test. You have got to show the figures.

22. Q. Do you understand the method as described in the paper by which Table 2 was obtained?

By Mr. Edmonds:

If it was described in the paper, it is evidence without this witness saying anything about it.

By Mr. Wooster:

I asked him if he understands it.

By Mr. Edmonds:

Are you going to come to rebuttal testimony soon?

A. I believe that was rule-of-thumb method also. I don't see any other indication to the contrary.—Yes, it does show there are no sulphur estimations made, and there is no record made of any real physical tests being made as to quantity.

23. Q. What do you understand to be meant by the activity of an accelerator?

A. Why, the activity of an accelerator, as I understand it, is the summation of the improvements in the physical properties produced by an accelerator when correlated with the time necessary to produce such improvements. I certainly would not consider any one factor alone as being adjudged an estimate of activity of an accelerator. That term "activity" is a misnomer in itself.

24. Q. Are the figures, as given in Table 1, correct?

A. From what standpoint, may I ask?

25 Q. Are they accurate?

A. Well, I can say from my own tests that I have not been able to duplicate that table, that is, duplicate parts of it.

26. Q. Have you tried to duplicate it?

A. Yes; that is, I have tried certain members to see if there was a certain relation with the anilin. I tried diphenylguanidine and triphenylguanidine in the percentages mentioned here—Yes, I tried most of those accelerators.

27. Q. State whether or not by the use of the parts of the various substances given in Table 1, you would obtain the identical effect as stated?

A. I was not able to obtain them.

By Mr. Edmonds:

I object to all this as irrelevant. The figures in that table are the same figures that Weiss used, and that Weiss used in his application for employment at Firestone, and the same figures he said he used when he went to Doty & Woodward,

and asked for employment, when he said he imparted or disclosed diphenylguanidine. So this witness's testimony would not add anything.

By Mr. Wooster:

It does not appear in this record that Mr. Weiss ever used the figures in this Table 1 in applying to Firestone, nor in applying to Messrs. Doty & Woodward. This table has been advanced here by defendant as disclosure of the entire subject.

Objection overruled.

Exception noted to defendant.

28. Q. If you used one part of the anilin in a given compound, do you get the same result as if you used .075 of diphenylguanidine or monophenylguanidine, or if you used .5 of triphenylguanidine?

A. I was not able to duplicate that ratio at all. In fact, by adding the percentages which he specified here—that is, .075 of diphenylguanidine, in the formula which he mentions—I obtained a decrease in the tensile from the raw rubber without any accelerator whatsoever. I did that three times. It is not accidental. And, moreover, there is a published article by an author named Ames, who produced the same results; and that is a British publication, and I am sure it is unbiased. I believe there were three materials that gave me either a drop in the tensile or the same tensile, and those three were monophenylguanidine, diphenylguanidine, and I think the other was monophenylthiourea.

29. Q. Will you go on with that paper, particularly Tables 1 and 2, and the conclusions expressed

by the writers at the end of it, and state whether or no you agree with same, giving your reasons?

By Mr. Edmonds:

That is typical of the sort of testimony I think should not be admitted.

By the Court:

We will admit it, Mr. Edmonds, under your objection, and note you an exception.

A. Well, this first comparison says that the test should be based on the values obtained by the sulphur coefficients for the control which contains no accelerator. I do not see any control with no accelerator in this list. It says, "The action of certain substances, such as diphenylthiourea, is due to their tendency to decompose under vulcanizing conditions and temperatures into simpler substances which contain an active nitrogen group, which is responsible for the acceleration effected." I believe in the disclosure in this paper, he said that the activity of some of these bodies was due to the formation of anilin—breaks down into anilin—and we are led to believe that that is the active material; yet his table shows that anilin is less active than any of the materials which break down into that body.

We are led to believe, from No. 3, that "molecularly equivalent quantities of substances which contain the same active nitrogen group in their primary nucleus effect the same accelerating activity." I don't exactly get what he means by that, and I see no relation of that to the table. He says, "The replacement of the hydrogen in the active nitrogen group by other and larger groups, or radicals, decreases the

activity of the parent substance." That does not stand up under the fact he claims these materials broke down into anilin—that is, you would expect diphenylguanidine to produce one of anilin, and triphenylguanidine to produce two of anilin, phenyl mustard oil on the side in each case, and therefore triphenylguanidine should be more active than diphenylguanidine. I think that is an erroneous conclusion.

Under conclusion 5, he states the activity of these materials is based on the change of the valency in the nitrogen group. I am not prepared to say whether that is or not. I don't know.

30. Q. Under conclusion 4, he states that "the replacement of the hydrogen in the active nitrogen group by other and larger groups or radicals decreases the activity of the parent substance." Now, taking monophenylguanidine, diphenylguanidine and triphenylguanidine, which, according to that conclusion, should be the more active?

A. Monophenylguanidine.

31. Q. Why?

A. Because it only has one hydrogen replaced by a larger group, whereas triphenylguanidine has three hydrogens replaced. I might state there that one of those replacements is on what is known as the amino groups, which group is not definitely established as to its importance in acceleration work.

32. Q. Have you ever compared the strength of diphenylguanidine and monophenylguanidine?

A. Yes.

33. Q. Are they the same?

A. Well, they are very nearly the same, as far as my tests showed.

34. Q. What was the melting point of your diphenylguanidine?

A. Diphenylguanidine was—

35. Q. Your monophenylguanidine?

A. Monophenylguanidine melts—My material melted at 64 to 67—was the range over which it melted.

36. Q. In this paper, on page 12, monophenylguanidine is stated to melt at 193 degrees C. Would you say that that was the same or different material than your monophenylguanidine?

A. Well, it couldn't be the same, with that wide variation in melting point. If it was off just four or five degrees, perhaps, I would say that it might be, but not to that extent, by any means.

37. Q. Have you any idea, from the testimony of Mr. Kratz and from this paper, as to what the substance was, really was, which melts at 193 degrees C.?

A. I haven't the slightest idea of what that could be.

38. Q. Do you consider that sulphur coefficient is a proper way of evaluating accelerators?

A. It depends upon the purpose of your evaluation. If you just want a comparison of totals, to find which one causes the most sulphur to react on rubber at a certain time; yes. If you want to find the paramount degree of the qualities, I have not been able to find any correlation.

39. Q. What relation have you found between sulphur coefficient and the physical qualities of the

rubber, such as tensile, aging, set, elongation, and the other qualities you usually investigate rubber for?

A. There seems to be no relation. I have to base, however, that opinion largely from literature, as my sulphur determinations are very few and far between, but I can confirm that by my experiments, where I have used as low as one and one-half sulphur, and given quite long cures, so that I know that most of it goes in. That means that the sulphur coefficient could not possibly be greater than 1½ per cent., and with diphenylguanidine and some of these other rapid materials, we are able to get physical properties better than—fully as good as, or better than, the tests made over long lengths of cure, where 5 to 7 per cent. of sulphur has been added. The probability is, your sulphur coefficient is very much in excess of that.

40. Q. Will you explain what you mean by "sulphur coefficient"?

A. The sulphur coefficient that I am speaking of is the percentage of combined sulphur in the rubber. This is, if you have 100 rubber and 1½ parts of combined sulphur, then the coefficient is understood as 1½.

41. Q. And by "combined sulphur," you mean the sulphur which has been caused to go into combination with the rubber, as distinguished from the free sulphur, which did not combine?

A. That is right.

42. Q. Was this lecture at Philadelphia the first time you had heard diphenylguanidine suggested as an accelerator of rubber?

A. I believe so.

43. Q. When did you next hear of it?

A. The next time I heard of it was—

By Mr. Edmonds:

Is this rebuttal of something?

By Mr. Wooster:

Yes.

By Mr. Edmonds:

When this witness heard of something the second time, I can't see that that is rebuttal of anything.

By the Court:

I don't see that that is rebuttal. What are you contradicting, Mr. Wooster?

By Mr. Wooster:

I am proving the utility of diphenylguanidine over triphenylguanidine.

By the Court:

There was some testimony along that line. Go ahead.

A. Some time after I had received the sample of XLO—I believe it was in the summer of 1921, I am not quite certain of that—it was in the summer of 1921 that I learned of diphenylguanidine as such an accelerator. I had heard of XLO in the fall of 1920, receiving a sample of that material, which I tested out early in 1921.

44. Q. In your first test of XLO, what did you conclude the active principle to be?

A. I had an analysis made, and the melting point was all right, and corresponded to monophenylurea—I believe it was—it was very close, 146½ as against 147, and my conclusion at that time was that it was a monophenylurea, which of course I know now was in error.

45. Q. What did you later find XLO to be?

A. I don't know how I found out, but I later found out that it was diphenylguanidine. I don't recall whether I was informed by one of our agents, or who was the informant.

46. Q. Did you later test XLO and diphenylguanidine in comparison with hexa—

A. I made many tests.

47. Q. —and triphenylguanidine?

A. Yes, I made a great many tests. I must say that I never evaluated a material on a few isolated tests.

48. Q. You tested these various accelerators in the same compound, at different cures?

A. In similar compounds, yes—the same compound.

49. Q. And where you varied one ingredient for one accelerator, you went through that for the other?

A. Yes; that is my procedure.

50. Q. Will you compare hexamethylenetetramine, triphenylguanidine and diphenylguanidine?

A. In what respect?

51. Q. In respect to the time of cure, quantity required, cost of accelerator, qualities imparted to the rubber?

(Pending an answer to the above question, Court adjourned to Friday, October 16, 1925, at 10 o'clock, A. M.)

Friday, October 16, 1925.

MORNING SESSION.

CARL S. WILLIAMS resumed the stand.

DIRECT EXAMINATION (continued).

By Mr. Wooster:

52. Q. At adjournment yesterday, you were requested to compare hexamethylenetetramine with triphenylguanidine and diphenylguanidine, in respect to times of cures, quantities required, costs and qualities imparted to the rubber. In making this, please make it as briefly as you can.

A. In comparing diphenylguanidine with triphenylguanidine, it has been our experience through many tests that triphenylguanidine takes very much longer times, periods of times, to obtain the optimum cure. When those optimum cures have been reached the tensiles obtained are not as great as obtained with diphenylguanidine. The quantities necessary to be used for triphenylguanidine are, as have been shown many times here, much greater than for diphenylguanidine.

In reference to hexamethylenetetramine, the difference is not so marked. If it is possible to evaluate this in exact terms, regarding their relative activities as defined in my definitions yesterday, I would say that one-half a part of diphenylguanidine is very close to the equivalent of one hexa. Of course this ratio

varies with different stocks, and it is impossible to make one ratio hold for all those stocks. I wish to quote or read from some of my reports; just the conclusions. I will not bother the Court with the figures. It is the report of February 4, 1921, signed by my assistant, Mr. Culver, and made under my directions and supervision. "The tensiles obtained by using XLO in pure gum stock are approximately 20 per cent. greater than those obtained with hexa. XLO gives tensiles of approximately 45 per cent. greater than those obtained with hexa, when used with a magnesia stock. By that I mean a stock containing magnesium oxide. The tensiles obtained by using XLO in zinc stock are greater than those obtained by using hexa. XLO reaches its maximum tensile in a cure that is from one-quarter hour to one-half hour shorter than that required by hexa."

I also wish to quote my own letter to our Mr. Dill, who was on the stand here a few days ago. It is dated February 7, 1921. I am speaking of XLO and I say, "Our tests on this material, copy of which we are enclosing, show it to be superior to hexa under all conditions tried. It not only produces a tougher stock but produces it in a shorter length of time than can be produced by hexa. Altho I have not completely established the identity of this material, I have conducted some tests which indicate it to be phenyl-urea. The material as marketed is a mixture of about equal parts chalk and active ingredient. This material is such a threatening competitor that we should take some steps to combat it. I would suggest the best means as being to make it and sell it our-

selves under its true name, if this can be accomplished."

I now quote from the report of Mr. Rose, who is also my assistant, and worked under my direction and supervision—

By Mr. Edmonds:

Will your Honor want it on the record? I object to it as irrelevant.

By the Court:

It may go in.

A. It is dated November 4, 1921: "Conclusions. XLO produces a stock superior to that produced by hexa. and in a shorter time. Diphenylguanidine showed a decided superiority over hexa. in both groups used" (this is a different mix of cures that he refers to), "exceedingly high tensiles being produced."

I also quote my letter to Mr. Dill, dated March 25, 1922, which date I believe is prior to the issuance of the Weiss patent. I will read only the last sentence now, "We cannot help but consider that this accelerator is the best accelerator for tire stocks that we have yet come across." The entire letter is as follows: "Mr. C. Dill, Asst. to 2nd Vice Pres. My dear Mr. Dill: Accelerators. We are attaching complete reports on tests made recently on various accelerators. I wish to draw particular attention to the results shown for diphenylguanidine. It appears from these tests that diphenylguanidine is very much more rapid than hexa. in all stocks tried. The tensiles produced in a stock containing a small amount of zinc were very nearly the same for the two materials, but

the period of maximum cure is very much shorter for that of diphenylguanidine. When tried in the stocks containing a high zinc content we find that the speed of the reaction of diphenylguanidine is very striking. When operating at 307° F., corresponding to a pressure of 60 lbs., we find that we are able to produce a tensile strength of 3446 lbs. in 5 minutes, whereas the maximum under the same condition for Hexa is only 2687 lbs. which is produced in 30 minutes. Also for these two stocks we find that the elongation for diphenylguanidine is 730 as against 520 for hexa. which shows that the diphenylguanidine has produced a better stock physically than the Hexa produced. At 50 lbs. and 40 lbs. the length of time necessary for maximum cures when using diphenylguanidines are about ¼ as long as it is necessary to cure to the maximum when using Hexa. At the same time the diphenylguanidine stocks in every case show a very much superior maximum tensile strength. These results would show that if a tire manufacturer used diphenylguanidine as his accelerator, he would be able to produce a very superior article by using a low per cent. of diphenylguanidine and curing for a fairly long period at a low temperature. In this manner he would be able to thoroughly heat his tire thru, which would facilitate the proper vulcanization of the underlayers, that is, skim coat, friction and breaker. The formulas for the underlying stocks could readily be adjusted by putting a slightly larger quantity of diphenylguanidine in them so that they would reach their optimum cure at the same time that the outer coat or tread reached its optimum cure. We cannot help but consider that this accelerator is

the best accelerator for tire stocks that we have yet come across. Very truly yours, Perth Amboy Chemical Works, C. S. Williams, Assistant Works Manager."

By the Court:

53. Q. How long had you been acquainted with that product XLO?

A. The first I heard about XLO was in the fall of 1920. Our salesmen and service men were getting reports that this new accelerator was making inroads on our business, and I immediately obtained a ten pound sample and conducted tests on that ten pound sample. I found it was a very rapid material, and urged in a letter to Mr. Dill, in the early part of 1921, that we analyze this material and find out what it is, and if possible market it under its true name, rather than calling it XLO.

Now, comparing diphenylguanidine with hexa. and thio., that is part of my conclusions. The relative costs of these substances I think Mr. Woodward has already shown to the Court that eight parts of triphenylguanidine, costs a great deal more than one part of diphenylguanidine, which seems to be the ratio admitted as being equivalent. Hexa. costs a little bit more than diphenylguanidine, to use.

By Mr. Wooster:

54. Q. Can you produce a bottle of diphenylguanidine, about an inch in diameter and several inches tall, as referred to by Mr. Baldwin?

A. Yes, sir; I have it here.

55. Q. Will you describe this bottle; what the figures on it mean?

A. This bottle is about 1-1/16 in diameter, and approximately 5 inches tall. We have added diphenylguanidine in five gram portions and calipered the strip on the side where these five come. The first five grams lie below my finger there (indicating).

56. Q. And the total amount is about what?

A. 35 grams exactly.

By Mr. Wooster:

I offer in evidence as Plaintiff's Exhibit No. 18, a graduate bottle containing diphenylguanidine.

57. Q. Have you ever made monophenylguanidine?

A. Yes.

58. Q. Did you get a melting point which agreed with that, as given by Mr. Kratz in his paper, of 193?

By the Court:

I don't know what you propose to prove in that regard. Is it to rebut something?

By Mr. Wooster:

Yes. That is, that Mr. Kratz did not have monophenylguanidine, and therefore had no basis in his paper for the alleged comparison given by him of the same activity. This paper is wrong in that respect.

By the Court:

This is now to rebut the testimony of what witness or what testimony?

By Mr. Wooster:

It is to rebut what is shown by the defendant's exhibit Kratz paper, as to the equal activity of monophenylguanidine and diphenylguanidine.

By the Court:

It is, in effect, a criticism of that paper. Go on.

A. The point we obtained is 66 degrees. To be more exact, between 64 and 67.

By Mr. Wooster:

59. Q. How was that substance prepared?

A. That was prepared by the action of free cyandiamid on anilin-hydrochloride.

60. Q. Have you a published reference to that method?

A. I believe it first appeared in about 1887. The author of it I do not know, but it was followed up and elaborated on by Prof. McKee, of Columbia University, who made it by that method, and described its properties, and called it monophenylguanidine.

61. Q. Will you look at the page I show you from the American Chemical Journal of 1901, vol. 26, page 221, and state what that is?

A. This describes the method which I just also described for making the monophenylguanidine. It gives the melting point as being 66. It says, "It decomposes on attempt to distill it and the free base is hydro , and takes up carbon dioxide. For identification, various derivatives were made." This is the article by McKee, although the name does not appear on this sheet.

By Mr. Wooster:

This photostat is offered in evidence as Plaintiff's Exhibit No. 19, being a photostat of American Chemical Society Journal, page 221, preparation of monophenylguanidine.

62. Q. I show you a chart, and ask you to state what it is?

A. This chart shows the relative activity as given by Mr. Kratz in his Table 1 and Table 4 of three substances, anilin, diphenylthiourea and triphenylguanidine. I have taken those three because they are the only ones that appear in both tables. In the first table, the equivalent amounts are, one of anilin to 85/100 of thiourea, and 50/100 of triphenylguanidine. In Table 4, he uses 40/100 parts of anilin, and obtains a sulphur coefficient of 3.6; with diphenylthiourea, one part of the material is used and gives a sulphur coefficient of 3.078. In triphenylguanidine, he uses 1.25, being about three times the amount of anilin, and gets a sulphur coefficient of 3.87, being only slightly greater than he obtained with 40/100 of aniline.

By Mr. Wooster:

The chart is offered in evidence as Plaintiff's Exhibit No. 20.

63. Q. Have you read and do you understand the disclosure of the Weiss patent in suit, No. 1,411,231?

A. Yes, sir.

64. Q. In this patent is given, by way of example, a formula consisting of 50 parts new rubber,

45.3 of zinc oxide, 3.5 sulphur, 1 part diphenylguanidine, to be cured for 10 to 20 minutes, at about 40 pounds per square inch. What kind of goods will that formula exactly as stated produce?

A. You could produce with that formula a very good quality of tennis balls, toys, rubber gloves, certain grades of rubber heels, white soles of tennis shoes, soft gaskets, white aprons, hospital sheeting, door stops, miscellaneous bumpers, and a big use would be for tire rubber stocks, inner tube patches, white tubing, white hose, water bottles, ice packs, jar rings, miscellaneous toys, rubber stoppers and caps, flush tank bulbs, and I think we could go on ad infinitum pretty nearly.

65. Q. I show you a chart which has been put out some time ago, by a manufacturer of diphenylguanidine and other accelerators for the vulcanization of rubber, showing a cross section of an automobile tire, with eleven different compounds mentioned therein, of which diphenylguanidine is mentioned in nine. Does that chart indicate correctly the places where diphenylguanidine may be used in an automobile tire and inner tube?

By Mr. Edmonds:

Of what is this rebuttal?

By Mr. Wooster:

It is in rebuttal of witnesses for the defendant, who said that this patent lacked utility and in substance that it was inoperative.

By The Court:

There was testimony in regard to the comparison to some other, as to certain of the re-

sults claimed, and it may be to the extent of the utility as claimed for it; but there was none which absolutely denies it, as I recollect.

By Mr. Wooster:

But they claimed the disclosure of the patent was insufficient.

By the Court:

It seems so absolutely and utterly remote from any consideration the Court would give to that phase of it, when, as counsel just stated, they have an admission upon the record as to the use of the substance. Now, I will say to you that in so far as that is concerned, you are wasting your own time and the time of the Court by the introduction of that testimony, if that is the only purpose of it.

By Mr. Wooster:

I will not press it.

66. Q. I show you a chart and will ask you to state what it is?

A. This is again the chart as given by Kratz in his paper, showing the relative equivalent amounts of various accelerators. The first column shows the figures as actually given by Kratz. The second column shows these figures converted into per cents, based on the gum used. The third column represents the figures in the same ratio, multiplied by the same factor, so that it brings diphenylguanidine to the quantity or near the quantity suggested in the patent; that is, two per cent. The last column shows this conversion to the ratios, bringing the diphenyl-

guanidine to the quantity used by defendant. I will cite the third column only. If I bring the percentage that is this ratio multiplied by the factor of diphenylguanidine, up to approximately two, up to exactly 1.95, it would mean that to obtain the same relative activity we must add 26 per cent. of anilin, which of course every rubber compounder knows is impossible. You cannot add it. The stock would run all over the floor. It is very soft. It also shows that you would have to use 22.1 parts of thiocarbanilid, 11.95 anhydroformaldehydeanilin. These quantities of course we know are absurd for use as accelerators in vulcanization.

67. Q. In your opinion, if you did use the amounts corresponding to the third column, would you get the same result in the case of each of those accelerators as is stated to be obtained in the patent in suit, by using the percentage of D. P. G. equaling 2 per cent. of the rubber?

A. The results would be absolutely impossible. They would be out of alignment. You couldn't get a cured stock containing 26 parts of anilin. If you would vulcanize that I don't think you could get it out of the mold; it would be in a flowing condition.

CROSS-EXAMINATION.

By Mr. Edmonds:

X68. Q. Did Roessler and Hasslacher make hexa.?

A. Yes.

X69. Q. And sold it to the tire companies?

A. Yes.

X70. Q. Did those companies make tires?

A. No.

X71. Q. In the tests on which you based your conclusions this morning, those tests were made with the same compound except for the accelerators and with the different accelerators in equal amounts, and the compound cured for an equal time?

A. No; not necessarily.

X72. Q. But the amounts in the accelerators were the same in the comparative tests you used?

A. The tests I have stated covered a great many comparisons. Some, as in this first one, are made on equal quantities. I have other tests here in which I have varied the quantities over quite a range.

X73. Q. But when you said in discussing the conclusions based on this first paper, that the tensiles obtained by using XLO are 20 per cent. greater, you referred to tests using equal amounts of hexa. and whatever the other accelerator was?

A. Yes.

DR. GEORGE STAFFORD WHITBY, recalled on behalf of plaintiff in rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Wooster:

192. Q. Have you heard the testimony of witnesses for the defendant and plaintiff as to the paper by Messrs. Kratz, Flower and Coolidge, published April, 1920, relating to comparisons of accelerators?

A. Yes, sir.

193. Q. Will you state your opinion as to what

that paper actually gave to the rubber world, giving your reasons?

By Mr. Edmonds:

I don't think that is a proper question. What is in the paper and what is written there now, and what one reads on the page, is the only thing that is of consequence. If counsel thinks there is something there that the Court cannot understand by reading it, he should be permitted to question about that, but nothing beyond that.

By Mr. Wooster:

194. Q. Does the paper by Mr. Kratz accurately state the relative activities of the substances mentioned?

A. No.

195. Q. Please give your reasons?

A. The figure given by Mr. Kratz for the relative activity of a variety of substances—I am especially referring to the figures in his Table 1—are grossly erroneous. The paper as a whole, considered as a whole, is inconsistent in itself. His results are inconsistent with the previous work he did at Norwalk. And furthermore, in so far as in later articles he reconsidered some of the matters dealt with in that April, 1920, paper, he entirely altered his position, and stated in effect that the previous conclusions were erroneous.

196. Q. In your opinion, if triphenylguanidine was known in the art as an accelerator of the vulcanization of rubber, could it have been predicated that diphenylguanidine would be an accelerator?

A. No.

197. Q. Will you give your reasons?

A. Because in considering triphenylguanidine and diphenylguanidine one finds that the main difference between them is a difference in the substitution. In passing from triphenylguanidine to diphenylguanidine we are confusing the substances. Now, there is no principle by which it could have been predicted that such a reduction of the substitution would have increased the accelerating properties, or even that it would have given you a substance that wasn't an accelerator at all. I have prepared a chart showing that in many cases a change of substitution may actually entirely destroy all the accelerating properties, or it may diminish them to a tremendous extent, so as to convert what was a superior accelerator to an extremely weak accelerator. I don't think I need go over all those examples, but these are perfectly well recognized cases. I might take as a typical one a case which is mentioned in the paper by Kratz, Flower and Shapiro, in January, 1921. They find there that hydrazinebenzol, which is hydrazine with two phenyl groups—let us say diphenylguanidine—accelerates vulcanization; whereas monophenylhydrazine actually retards vulcanization. So if there is a diminution in the amount of substitution, it actually destroys all accelerating power.

By Mr. Wooster:

The chart produced by the witness is offered in evidence as Plaintiff's Exhibit No. 21, Whitby Chart showing effect of Substitutions.

198. Q. With an aminoguanidine mentioned in the Dubosc article of 1919 as an accelerator, in your

opinion, could that disclosure enable one to predicate that diphenylguanidine would be an accelerator?

A. No. I have given examples on the chart showing that the removal of an amino group may give a substance which has no accelerating power whatever. Therefore, it could not have been predicted, because aminoguanidine, or diaminoguanidine, is not an accelerator. I may say that the same applies to any suggestion that might be made that it could be predicted that phenylguanidines would be accelerators.

199. Q. To your knowledge, has diaminoguanidine ever been prepared in a free state?

A. No; it cannot be prepared in a free state.

200. Q. Mr. Bridgwater discussed his understanding of the meaning of the term "substitution," as applied to diphenyl and other guanidines. Will you state whether or not you agree with that understanding as expressed by Mr. Bridgwater, and state your reasons?

A. No, I don't agree with Mr. Bridgwater's definition, and I may say I have given some rather close consideration to questions of commercial nomenclature, as I happen to be a member of the International Committee on the Reforming of Nomenclature of Organic Chemistry, and it appears to be obvious that the term "substitution" implies that a mere substitution is contemplated; that is to say, a change which shall not destroy the fundamental character of the material in question; that the material obtained shall be able to function in substantially the same way as the original material, and that undoubtedly is the meaning of the substitution contemplated in the patent, and it also, in my view, would be very good from

a strictly chemical point of view, that any change which alters the character of a compound fundamentally cannot certainly be considered as a substitution. Such compounds as dibenzolguanidines are not disubstituted guanidines, and when you introduce the sulphonic group, as in some of the compounds submitted, you are certainly entirely altering the character of your compound, and in my opinion you will not really make a substitution.

By Mr. Wooster:

With the offer of some exhibits, plaintiff's rebuttal will be closed.

CROSS-EXAMINATION.

By Mr. Edmonds:

X201. Q. You have changed your mind about the Kratz paper since the time it first came to your attention?

A. I think not.

X202. Q. In your letter to Mr. Kratz, of October 30, 1919, do you find the statement, "So far as I can judge from the abstract the paper of yourself, Flower and Coolidge, on accelerators, is remarkably interesting and satisfactory"?

A. Yes, but one couldn't judge very far from the abstract, which gave no quantitive figures, and certainly did not include any figures of the relative activity of accelerators, and did not include his theory as to the mode of action.

X203. Q. And when you referred to this paper which was published in 1920 as a paper which might be referred to for information on accelerators, did you

think it worth while to say you didn't agree with it, and thought it was wrong?

A. No; because in the first place I was not acquainted with his Norwalk work, and which, as I say, is entirely inconsistent with his subsequent work, assuming that he carried out this experiment that he embodies in Table 1. Furthermore, his paper of April, 1922, or February, in which he throws over all the work in his 1920 paper, he reconsiders, had not appeared when I wrote him.

X204. Q. How long have you known the facts on which you now base your criticism of this Kratz paper?

A. Some of those facts are actually mentioned in that letter, because if you will refer to that letter you will find there is a criticism of the paper, to the effect that he failed to carry out tensile tests on his record.

X205. Q. And other criticism you have made quite recently?

A. No; because in Mr. Kratz's paper of April, 1921, he entirely contradicts, and as I believe shows the substitution to be erroneous.

X206. Q. You haven't learned anything recently about the things you criticized, the exact figures in his Table 1?

A. Naturally, I am using some of my more recently acquired knowledge; but there is already a paper in the journal of the Society of Chemical Industry, about on May 10, 1920, by Twiss, the results of which show that Kratz was entirely in error with regard to thiocarbanilid.

By Mr. Wooster:

To close plaintiff's case, and without recalling Mr. Doty, I would like to offer a chart showing a comparison of accelerators, as based on experiments made by Mr. Doty and used in the National trial.

By Mr. Edmonds:

I object to this as irrelevant, because it is a perfectly useless thing in the respect that it is a part of curves of different accelerators of different accelerating values, used in the same amount, which is obviously a foolish thing to do.

By the Court:

We will allow it to be admitted.

By Mr. Wooster:

I offer it as Plaintiff's Exhibit No. 22.

By Mr. Wooster:

I also offer India Rubber World of December 1, 1919, pages 137 to 140, inclusive, article by D. F. Cranor, being Exhibit No. 23.

I also offer Patent to George D. Kratz, No. 1,428,040, filed May 26, 1919, for a tire, to show that the mind of Mr. Kratz was not on diphenylguanidine at that time; being Exhibit No. 24.

Also, the Rubber Age of February 25, 1921, pages 401 and 403, article by Kratz, Flower and Shapiro, relating to the action of certain organic accelerators in the vulcanization of rubber; being Exhibit No. 25.

I also offer in evidence paper by W. M. Ames in the Journal of the Society of Chemical Indus-

try, of April 25, 1924, pages 117-T and 125-T; being Exhibit 26.

I also offer page 740, of the India Rubber World, of July 1, 1921, an article relating to XLO, being Exhibit No. 27.

I also offer photostat of pages 283 and 284 of Berichte, 1905, vol. 38, Sec. 53, article by Pellizzari and Cantoni, on diamino guanidine, being Exhibit No. 28.

I also offer from the India Rubber Journal of May 20, 1922, pages 17 to 21, inclusive, an article by Dr. Lothar Weber, on Survey of Accelerators, being Exhibit No. 29.

I also offer a copy of the application of Morris L. Weiss, filed August 8, 1921, Serial No. 490,746, being the applicaion involved in the *Scott vs. Weiss vs. Heuser Interference,* the record heretofore offered. This copy is uncertified, but is accepted by defendant, being marked Exhibit No. 30.

I also offer to read into the record Rule 75 of the Rules of Practice of the United States Patent Office, which was in force in 1921 and 1922, the same being as follows:

> "75. When an original or reissue application is rejected on reference to an expired or unexpired domestic patent, which substantially shows or describes but does not claim the rejected invention, or on reference to a foreign patent or to a printed publication, and the applicant shall make oath to facts showing the completion of the invention in this country, before the filing of the applica-

tion on which the domestic patent issued, or before the date of the foreign patent, or before the date of the printed publication, and shall also make oath that he does not know and does not believe that the invention has been in public use or on sale in this country, or patented or described in a printed publication in this or any foreign country for more than two years prior to his application, and that he has never abandoned the invention, then the patent or publication cited shall not bar the grant of a patent to the applicant, unless the date of such patent or printed publication be more than two years prior to the date on which application was filed in this country."

I also will read into the record a table showing equivalents in pounds and degrees of the various steam pressures and temperatures that have been referred to in this case, the references in some cases being to pounds and in other cases to degrees Fahrenheit, and in others to degrees Centigrade:

PRESSURE-TEMPERATURE EQUIVALENTS OF SATURATED STEAM AT SEA LEVEL

Gauge Pressure Lbs. per Sq. In.	Approximate ° C.	Temperature ° F.
0	100	212
5	109	227
10	115	239
15	121	250

20	125	258
22	127	261
24	129	265
26	131	268
28	133	271
30	134	274
32	136	277
34	138	280
36	139	282
38	140	285
40	141	287.6
42	143	290
44	144	292
46	145	294
48	147	296
50	148	298.4
52	149	300
54	150	302
56	151	304
58	152	305
60	153	307
65	155.5	311.5
70	158	316
75	160	320
80	162	324
85	164	327
90	166	330
95	168	334
100	170	337

I also offer as Plaintiff's Exhibit No. 31 a page from Thorpe's Dictionary of Chemistry, Edition of 1912, an article relating to diamino

guanidines, this being the article which was shown to Mr. Bridgwater in cross-examinaiotn.

PLAINTIFF RESTS.

By Mr. Edmonds:

For the defendant, there were seven depositions from the Aniline case that was stipulated in here. Some of them are very brief, and can be disposed of in a word.

Mr. Kinsman, who worked for the DuPont Company, took the stand and said the DuPont Company had put diphenylguanidine on the market prior to the issuance of this Weiss patent, and that they did it with a knowledge of the Kratz paper, having heard the paper read in 1919. Mr. Morse, an employee of the Atlantic Dyestuffs Company, took the stand and said his company had been preparing to put diphenylguanidine on the market before the issuance of the Weiss patent, and that preparations were complete shortly after the patent issued, and he said in doing so he and his company were familiar with the Kratz paper. As I recall, Mr. Morse said he was at this Philadelphia meeting and heard the paper read. Third, a Mr. Loebenberg testified that he was in the employ of the National Aniline Company, and that it was to him that Weiss came when he solicited employment in March of 1920. He had Weiss make out a formal application blank, a copy of which is in evidence in this record. The point about that is that on the back of it is written the

name of Dr. Kratz, showing that Weiss mentioned Kratz's work on diphenylguanidine in talking with Loebenberg and soliciting employment with the National Aniline Company, and that this witness said that Weiss did not say in the course of his discussion with Loebenberg seeking a job, that he had originated the idea of using diphenylguanidine as an accelerator, but merely that he had done something in the way of devising a process of making diphenylguanidine.

Next there is the deposition of Mr. Shapiro, who was in the employ of the Firestone Rubber Company in March, 1920, at the time when Weiss went there seeking employment. Weiss met this man Shapiro, and in talking with him he said that he had been working on accelerators, and referred to Kratz as having shown the value of diphenylguanidine, and said that he, Weiss, had devised a process of making; that is, in substance, what he wrote on the application blank that Shapiro handed him and told him to fill it in. Shapiro attended this Philadelphia meeting at the instance of the Firestone Company, and heard the Kratz paper and saw the Kratz tables posted on the blackboard, and took copies of the tables, which he took back to the Firestone Company with him. In speaking of the Kratz paper, he said, "Well, it was the first paper which gave us any definite idea of the relative activity of accelerators, and as such was an extremely important paper, because having these relative activities, we were able to apply the various accelerators sensibly. In talking with Shapiro, Weiss never claimed

that he had been the originator of the idea of using diphenylguanidine as an accelerator. Instead, Shapiro said that Weiss said to him, "Of course, you know that diphenylguanidine is a good accelerator, from what you have heard at the Philadelphia meeting." One more point in Shapiro's deposition is that prior to this talk between Shapiro and Weiss, the Firestone Company had been studying the guanidines as possible accelerators of rubber vulcanization. Whether or not that was prompted by Kratz's paper does not appear.

Next is the deposition of Mr. Russell, the man whom Kratz mentioned as his co-worker at the Norwalk Tire & Rubber Company. Russell corroborated Kratz in all respects relating to that work of Kratz at Norwalk. He was Kratz's immediate superior in the Norwalk laboratory. He knew what Kratz was doing, and was familiar with it He identified these records that were put in evidence, as showing Kratz's work at Norwalk. In fact, it was he who got those records from the files of the Norwalk Company and brought them with him and produced them at the trial of the Aniline case. So that he was fully familiar with all of that work, and his testimony corroborates Kratz in all respects.

Next there is a man by the name of Moore, a young chemist just out of college, who entered the employ of the Falls Rubber Company in June, 1917. He was the closest approach to an assistant that Kratz had at that time. He remembered the order for a thousand tubes by the Falls Com-

pany at that time, and filled by the company, and recalled that he had made certain tests on a grey tube rubber compound along in August, 1917, and he produced a test sheet made out by him in his own handwriting, in which the batch that he tested is identified by the same number, T-63, as appears on the Kratz formula for the rubber of those particular tubes. That test, in his handwriting, is in evidence in this case.

Lastly, there is the deposition of Mr. Clark, who appeared here, as I stated at the time he testified, but his testimony was taken over again. He testified that—of course we know that he was in the employ of the Republic Rubber Company. He said that at that time, along in 1917 and 1918, and the early part of 1919, the Republic Company was using thiocarbanilid as its main accelerator, and constructed a plant for the manufacture of thiocarbanilid for its own use. He said that they worked continuously on the development of triphenylguanidine until the latter part of 1919. He said that Daniels went to this Philadelphia meeting, and that was a thing they didn't know very much of, so when Daniels came back he tried to justify the trip, saying he had gained much useful information at the meeting, and Clark said to him specifically, "Did you get the 'dope' on accelerators?" He said, "Well, we are going to work now and produce the real thing." Clark said that thereupon the work on the development of triphenylguanidine stopped abruptly, and from then on the work on accelerators that was done at the Republic plant was

work on the development of diphenylguanidine. One further thing was that he understood it was the invariable rule in the Republic plant that all experiments made by any of the men working in the laboratory should be recorded in the X-book; that that was what the X-book was for; that he had made it his business to issue orders that all experiments be so recorded.

That covers the seven depositions introduced for defendant in, we think, sufficient detail for your Honor's consideration.

Opinion.

Filed February 3, 1926.

GIBSON, *District Judge.*

The plaintiff, Dovan Chemical Corporation, assignee of Morris L. Weiss, has brought its action against the defendant, Corona Cord Tire Company, for alleged infringement of Weiss Patent No. 1,411,231 for a vulcanization accelerator. The application was filed November 12, 1921, and the patent was granted March 28, 1922. The plaintiff prays the ordinary injunction, the delivery to the plaintiff or destruction of disubstituted guanidines (and particularly diphenylguanidine) which defendant may have, and an accounting.

Crude rubber, as such, is of little value. When mixed with sulphur and other materials, and subjected to heat, it becomes the rubber of commerce. This mixture and application of heat is termed vulcanization, and a "vulcanization accelerator" is a

material added to the mixture which not only hastens vulcanization (as its name indicates), but also increases the elasticity and otherwise improves the quality of the rubber article being manufactured. By the patent in suit monopoly in the use of diphenylguanidine and di-substituted guanidines, as such accelerators, is claimed.

The defendant, by stipulation, has admitted the purchase of diphenylguanidine, and use of it in the proportion of two-thirds of 1% of the rubber as an accelerator of vulcanization, but has denied the validity of the patent. It alleges that one Dr. G. D. Kratz, on September 6, 1919, more than two years before the application for the patent in suit, disclosed the subject-matter of the patent in a paper read at a convention of chemists engaged in the rubber industry held at Philadelphia, which paper was printed in the Journal of Industrial and Engineering Chemistry in April, 1920, and that thus the full information of the patent was anticipated. It further declares that Kratz was the discoverer of diphenylguanidine as a vulcanizer accelerator, not Weiss; that tubes made in 1917 by Kratz from a rubber mixture, with that accelerator, were sold; that Weiss was not an originator of the idea of the use of diphenylguanidine as an accelerator, having obtained it from one Baldwin, who had experimented therewith; and finally, that the patent does not disclose a patentable invention.

Plaintiff has particularly relied upon Claims 5, 8, 9 and 12 of the patent, which follow:

> "5. The process of treating rubber or similar materials which comprises combining with

the rubber compound a vulcanizing agent and a di-substituted guanidine accelerator."

* * * * * * *

"8. The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine."

* * * * * * *

"9. A vulcanizing compound of rubber or similar material combined with a vulcanizing agent and a di-substituted guanidine."

* * * * * * *

"12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine."

In view of the stipulated use of diphenylguanidine by the defendant, our inquiry in the instant matter is properly confined to a determination of the validity or invalidity of the 8th and 12th claims.

In discussing them, monophenylguanidine will be abbreviated to MPG, diphenylguanidine to DPG and triphenylguanidine to TPG.

It has been argued by counsel for defendant—and with considerable force—that, no matter who introduced the use of DPG as an accelerator, no patent for such use was an actual invention, or displayed the inventive faculty, when application was made as late as November 12, 1921. The contention is, in substance, that for at least six years prior thereto rubber chemists had accepted the fact that vulcanization accelerators were nitrogen-containing substantees capable of certain reactions in the presence of

sulphur. Among the substances known to meet the general chemical requirements of accelerators in this respect were the guanidines. which included MPG, DPG and TPG. TPG was known to be an accelerator, and was in use as such before the patentee, Morris L. Weiss, began his career as a rubber chemist; and prior to its use the possibility of the guanidines as accelerators had been suggested in magazine articles. DPG is closely related to TPG in chemical construction, and when it was established that the latter was an accelerator of value, it followed as a matter of natural presumption that DPG was also an accelerator. To determine the correctness of this presumption, and the value of the substance, and the best way to use it, the rubber chemist was required, it is claimed, to exercise no inventive faculty, but mere industry in making tests and the ordinary knowledge of his profession. With the knowledge of the fact that one member of a closely related group was an accelerator, the qualities of another member offered no greater problem to the chemist, except in time of solution, than would be offered to a pipe-fitter altering the plumbing in a building. Each would be required to use only the ordinary tools of his trade, the one his ability to prepare and treat a rubber composition, the other his wrench and mechanical ability.

While the contention, just stated, might require careful consideration under some circumstances, we have not based our decision upon it, but have come to the conclusion upon other grounds that the patent in suit is invalid. The testimony, in our judgment, conclusively establishes the fact that Morris L. Weiss was not the inventor or discoverer of the efficacy of

DPG as a vulcanization accelerator—the only actual disclosure of the patent.

It is manifestly impossible that a synopsis of the testimony be here given. Certain admitted facts, as well as disputed testimony, tend strongly to sustain the finding. Morris L. Weiss, having just received a degree in Chemistry from Cooper Union, of New York City, late in 1917, entered the employ of The Republic Rubber Company, of Youngstown, Ohio. That company was engaged in the manufacture of rubber articles largely made from "shoddy", or reclaimed rubber. Like most other rubber manufacturers, in 1918-19 it was interested in obtaining other and improved accelerators, but was specially interested in TPG, and was engaged in building a plant for its commercial use. Weiss, in addition to his usual work, was engaged in experiments upon accelerators, among them TPG. He was required by the rules of the Company to enter all his experiments in a book, called the "X Book" kept for the purpose. During the term of Weiss' employment, prior to September 7, 1919, this X Book shows two experiments with DPG as an accelerator, which are undisputed, and a third which shows a change of its original date and which defendant claims was subsequent to that date. The undisputed tests were with a "shoddy" mixture, and show no marked superiority of DPG over TPG. The disputed test was not with the shoddy stock of the company, and showed a considerable and marked superiority. On September 6, 1919, one Dr. G. D. Kratz, with a chemistry degree from Cornell University, read a paper upon accelerators before the American Chemical Society at Philadelphia. In it he fully disclosed

the subject-matter of the Weiss patent, more fully, indeed, than does the patent. *Inter alia,* he placed a table upon a blackboard, giving the comparative powers of DPG, TPG and other accelerators, aniline being the basis of the comparison. The immediate superior of Weiss in the Republic Rubber Company, M. H. Daniels, was present when this paper was read and copied the tables placed upon the blackboard; and this information was imparted to Weiss upon the following day. After this date the "X Book" shows the use of DPG in a number of tests. In March, 1920, Weiss was discharged by the Republic Rubber Company, and very shortly thereafter applied for employment to two other rubber manufacturers. In both his written applications he referred to the paper read by Dr. Kratz as showing the value of DPG as an accelerator, and stated that he had devised a method of manufacturing that substance cheaply; but in neither did he claim to have been the original discoverer of it as an accelerator. Later in 1920, Weiss with others organized the plaintiff company. On July 2, 1921, Weiss made application for a patent to cover his method of preparation of DPG, and received it on July 11, 1922. As stated, the application for the present patent was filed November 12, 1921, and the patent issued March 28, 1922. The patent examiner cited Dr. Kratz's paper before the Chemical Society, published in a magazine in April of 1920, as an anticipation of the patent. Upon affidavits being furnished by Weiss to sustain a claim that he had discovered the qualities of DPG as an accelerator prior to the Kratz paper, the patent eventually was issued. The proceeding in the Patent Office was entirely *ex parte,* and

no testimony was introduced to show any discovery by Kratz prior to the reading of his paper. It will be noted, also, that the patentee accepted the Kratz paper as a disclosure of the invention claimed in his patent and sought to show the priority of his own discovery, while in the instant case the plaintiff questions the sufficiency of the paper as a disclosure.

The patentee, Weiss, has testified that he began to investigate DPG early in 1918 and made a number of tests with it prior to February of 1919. Despite the rule that all tests should be recorded in the "X Book", no test of DPG appears therein prior to February, 1919, except one by Weiss' predecessor, Baldwin, in 1917. Three tests appear under dates of the early part of the year 1919. Of these, two are in connection with shoddy compounds, and were of little significance. The other now appears of the date "2-10-19." A casual examination discloses that the month has been changed; and an examination under a strong glass plainly shows that the "2" was originally "9", thus making the original date September 10, 1919, three days after Kratz's table of accelerators had been given to Weiss. This test was with new rubber, and not with shoddy, the ordinary stock of the plant. This has some slight significance in itself. Weiss in his testimony refers to this test as the first successful experiment with DPG.

After the meeting of the Chemical Society and the reading of the Kratz paper, a number of tests appear. Some of them are undated, it is true, and Weiss claims they were made in the Summer of 1919. Since they follow tests dated in October of 1919, and precede other tests dated in October, November and

December, it is impossible to accept his testimony in this respect.

The testimony of Weiss has been supported by other witnesses in the plant. Their testimony is intended to establish completion of the discovery of DPG prior to Dr. Kratz's paper on September 6, 1919. Chief of these witnesses was M. H. Daniels, the immediate superior of Weiss in the Republic Rubber Company. He has testified that Weiss discussed DPG with him early in 1918, and that he had knowledge that thereafter tests were being made of the substance. His exact knowledge of the progress of this investigation at any particular stage is by no means made plain by his testimony. Daniels attended the Chemical Society meeting at which the Kratz paper was read. Upon his return he delivered his notes of the Kratz paper to Weiss, and now alleges that he told Weiss that the paper confirmed their own findings as to DPG. But the exact nature of these findings does not clearly appear. That a complete discovery of the qualities of DPG had then been made, seems impossible under the surrounding circumstances. The test book actually showed only two inconclusive tests by Weiss. The Company during 1919 was mainly interested in TPG as an accelerator and was constructing a plant to manufacture it commercially; and it was investigating TPG as late as December 1, 1919, when Daniels wrote to one Stevens, a chemist of the Company, that he (Stevens) was spending "too much time on triphenyl. • • • Diphenyl is King pin now." The tests of DPG, subsequent to Kratz's paper, which were recorded, were quite numerous; but even so, the results were never im-

parted to the superior officer of Daniels, according to his testimony. (see Clark, p. .....). Daniels has stated that he did impart information of the investigation to Mr. Clark in the summer of 1919, but that he also said: "I wasn't prepared to say how good it was." Still more convincing of the unreliability of the claim of complete discovery prior to September 6, 1919, is the admitted fact that the Republic Rubber Company never used DPG in the manufacture of any goods prior to the departure of Weiss on March 1, 1920. If a complete discovery of the powers of DPG had been made by Weiss, and was known to Daniels, it is almost inconceivable that not one trial of it should be made in actual manufacture.

In addition to these side-lights on the testimony of Weiss and his supporting witness, Daniels, the testimony discloses certain other matters that materially affect the weight of their testimony. Despite the fact that the Republic Rubber Company never used DPG in making any articles, Daniels, in support of the patent application, made an affidavit wherein he stated:

> "These tests were also carried out in the compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods."

The manifest effect of the immediately foregoing was, at best, to create a false impression. In the same affidavit, a certain undated memorandum of test (copy

attached to affidavit) was alleged to have been made "early in the year 1919." Daniels, in the instant case, said the entry was made late in the year 1919 or early in the year 1920. The context plainly shows the entry was not made early in 1919. This was a vital matter before the Patent Examiner, and whether such inaccuracies of statement are the result of carelessness or otherwise, the effect of them is to seriously affect the credit to be given the whole testimony.

Weiss' testimony in the instant case shows various contradictions of statements made in prior steps in the case, some in regard to material matters. Mere variation in recollection at different times is not always vital; but when by means of the variations the testimony becomes more favorable to the contentions of the witness with each successive delivery, the Court is required to scrutinize it with some care.

Certain other witnesses have been produced on behalf of the plaintiff. They were employees within the plant of the Republic Rubber Company, connected with the chemists only in the handling of tests. Having kept no records, and being unacquainted with the accelerator in the mix handled, it is not probable they would remember exact dates at the end of seven years. We feel that the circumstances, as well as our observation of the witnesses, preclude us from giving great weight in the attempt to fix Weiss' discovery of DPG as prior to Kratz's disclosure.

The credible testimony shows that prior to September 7, 1919, the patentee, Weiss, made several tests with DPG; but those tests were so few in number and so inconclusive in results that no legitimate claim can be made to a knowledge of the superiority of

DPG over TPG as an accelerator. We find as a fact, therefore, that Morris L. Weiss did not independently discover the efficacy of DPG as an accelerator of vulcanization prior to the delivery of the Kratz paper on September 6, 1919, But even had our finding in this respect been otherwise, the testimony discloses that not only had another disclosed the subject-matter of the patent to the world in advance of the patentee, but that other had also discovered the qualities of, and had used DPG several years prior to the time claimed by the patentee as marking the beginning of his investigations.

In 1916, G. D. Kratz was a research chemist for the Norwalk Tire & Rubber Company. He had a degree in chemistry from Cornell University, and had been a rubber chemist for four years in 1916. In that year he prepared a quantity of DPG and established its efficacy as an accelerator by a number of tests. His investigation included a number of other accelerators, and a table was prepared by him which showed the comparative powers of the accelerators investigated. In this respect, his accomplishment was greater than that claimed by the patentee. While Kratz was engaged in this labor, his associates, Drs. Russell and Spence, were in touch with his work. They have testified to that labor and its results. As further confirmation a copy of Kratz's report to the Norwalk Company has been offered. In 1917 Kratz became Chief Chemist of the Falls Rubber Company. In 1917, he has testified, he used DPG in the manufacture of 300 tires, part of a consignment of 1000 tires sold. In 1918, Kratz repeated his tests of the various accelerators tested

in 1916 at Norwalk. His reason for so doing was his desire to verify the previous results in a rubber compound which did not contain zinc oxide, that material having been a part of the compound when the 1916 tests were made. These tests, with other labor necessary, furnished the foundation facts of the paper read September 6, 1919, and published in April of 1920. It has been urged by counsel for the plaintiff that the testimony of Kratz as to the actual use of DPG in the manufacture of tires should be ignored, because uncorrobroated, and points to the ignorance of subordinate employees of the Falls Rubber Company. There is some documentary evidence which tends to confirm this claim of use, but even if there were none we should not feel justified in rejecting it. To do so would be to impute wilful falsehood to Dr. Kratz, and neither his interest in this case nor his manner and appearance upon the stand was such as to furnish any foundation for that imputation. His knowledge of DPG and the general circumstances make the use of it as an accelerator quite probable.

It is further argued that Kratz's early investigations and discoveries were nothing more than abandoned experiments. The foundation of this claim seems to be based upon the misapprehension that no use of the idea other than actual manufacture or an application for a patent is an actual disclosure of it to the world and a reduction to practice. As a matter of fact the method of disclosure adopted by Kratz called the attention of rubber manufacturers to the discovery far more effectively than would have a patent application quietly filed in the Patent Office,

As to what constitutes reduction to practice, see *Curtiss vs. Janin,* 278 Fed. Rep., 454. Nor is the claim of abandonment to be established by pointing to the fact that no use of DPG followed Dr. Kratz's disclosure. In making use of such an argument counsel for plaintiff is attempting to bring the subject matter of this patent, to which plaintiff is not entitled, within the scope of another patent which does belong to it so far as the evidence of this case discloses. DPG was not used by rubber manufacturers after the Kratz disclosure, not because its efficacy was unknown or doubted, but because no method was known for its cheap manufacture. Weiss devised a method which made possible its commercial use, and, so far as appears, accomplished something of great value. He filed an application for a patent upon this method some five months prior to his application for the patent in the instant case, and eventually was granted it. But disclosure of a method of cheap manufacture does not entitle a patentee to claim a monopoly in the use of an article whose qualities were disclosed by another. Commericial use is one thing, discovery another, although, it is true, such use may, under certain circumstances, throw light upon the novelty claimed for a patented device. Those reasons do not exist here, where the reason for non-use prior to plaintiff's method patent fully appears.

In reaching our conclusion that Morris L. Weiss was not the actual and independent inventor and discoverer of DPG as an accelerator, we have endeavored to consider the questions involved without being unduly affected by the action of other Courts in litigation upon the patent in suit; and, owing to the differ-

ence in opinion in such Courts, we trust we have been able to do so.

Let a decree be drawn in accordance with the finding of above opinion.

Final Decree.

Filed February 13, 1926.

This cause having come on for trial on October 7, 1925, Now, after hearing James J. Kennedy, Esq., in behalf of the plaintiff, and Dean S. Edmonds, Esq., in behalf of the defendant, and the cause having been considered by the Court and an opinion having been filed herein on the 3rd day of February, 1926, it is hereby

Ordered, Adjudged and Decreed that Letters Patent of the United States No. 1,411,231, granted to the plaintiff as assignee of Morris L. Weiss, for Vulcanization Accelerator, are invalid and that the Bill of Complaint herein be, and the same is hereby dismissed with costs to the defendant to be taxed.

ROBERT M. GIBSON,
United States District Judge.

Approved as to form.

J. S. WOOSTER,
Counsel for Plaintiff.

Dated Feb. 10, 1926.

Petition for Appeal.

The above named, Dovan Chemical Corporation, the plaintiff, conceiving itself aggrieved by the decree rendered and entered in the above entitled cause on the 13th day of February, 1926, hereby appeals from said decree to the United States Circuit Court of Appeals for the Third Circuit, for the reasons set forth in the Assignment of Errors filed herewith, and prays that its appeal be allowed, that citation be issued as provided by law, that a transcript of the record, proceedings, evidence, papers and exhibits, and a copy of the opinion of this court filed in this cause, upon which said decree was based, duly authenticated by the Clerk of the Court, be transmitted to the United States Circuit Court of Appeals for the Third Circuit, under the rules in such cases made and provided.

DOVAN CHEMICAL CORPORATION,

By BYRNES, STEBBINS & PARMELEE,
Solicitors.

Dated: March 10, 1926.

Order Allowing Appeal.

On motion of Byrnes, Stebbins & Parmelee, solicitors for plaintiff, it is hereby

ORDERED

That an appeal to the United States Circuit Court of Appeals for the Third Circuit from the decree heretofore filed and entered herein, be, and the same is hereby, allowed; and that a certified transcript of the record, proceedings, evidence, papers and exhibits, and a copy of the opinion of this court filed in this cause upon which said decree was made and entered herein, be duly authenticated by the Clerk of this Court and be forthwith transmitted to said United States Circuit Court of Appeals for the Third Circuit, and that Citation issue to Corona Cord Tire Company, the defendant herein.

ROBERT M. GIBSON,
United States District Judge.

Dated: March 10, 1926.

Citation on Appeal.

United States of America, ss: to Corona Cord Tire Company,

Greeting:

You are hereby cited and admonished to be and appear before the United States Circuit Court of Appeals for the Third Circuit, in the City of Philadelphia, on the 11th day of October, 1926, pursuant to an appeal filed in the Clerk's office for the District Court of the United States of America for the Western District of Pennsylvania, wherein Dovan Chemical Corporation is appellant and you are appellee, to show cause, if any there be, why the decree in said appeal mentioned should not be corrected and why speedy justice should not be done to the parties in that behalf.

Given under my hand at the City of Pittsburgh, in the Circuit above named, on the 11th day of March, in the year of our Lord One Thousand Nine Hundred and Twenty-six.

ROBERT M. GIBSON,
United States District Judge.

Stipulation.

The plaintiff having taken an appeal from the final decree in the above-entitled suit, it is stipulated and agreed, with the approval of the Court, that the entire testimony taken at the trial in the form of questions and answers shall be used in making the appeal record.

BYRNES, STEBBINS & PARMELEE,
Solicitors for Plaintiff.

WINTER, BROWN & CRITCHLOW,
Solicitors for Defendant.

Approved:
JOSEPH BUFFINGTON,
United States Circuit Judge.

Pittsburgh, Pa.,
March 12, 1926.

Bond.

Know all men by these presents that we, DOVAN CHEMICAL CORPORATION of New York, New York, as principal, and UNION INDEMNITY COMPANY, a corporation of Louisiana, having an office at 1006 Keystone Building, Pittsburgh, Pennsylvania, as surety, are held and firmly bound unto Corona Cord Tire Company in the sum of One Thousand Dollars ($1,000.00), to the full and lawful payment of which, well and truly to be made, we do hereby bind ourselves, our successors and legal representatives and assigns, jointly and severally, by these presents.

In Testimony Whereof the said DOVAN CHEMICAL CORPORATION, by its President, and the said UNION INDEMNITY COMPANY, by E. W. Murphy, its agent and attorney in fact, have executed this instrument this 4th day of March, 1926.

Whereas, lately the United States District Court for the Western District of Pennsylvania, in a suit brought by the said DOVAN CHEMICAL CORPORATION against the said Corona Cord Tire Company a decree was entered dismissing the bill of complaint of the said DOVAN CHEMICAL CORPORATION, and the said DOVAN CHEMICAL CORPORATION proposes to appeal from said decree to the United States Circuit Court of Appeals for the Third Circuit.

Now, Therefore, the condition of this obligation is such that if the said DOVAN CHEMICAL CORPORATION shall mainatin its said appeal, or shall satisfy all costs in case of its failure so to do, this obligation shall be void; otherwise to be and remain in full force and effect.

DOVAN CHEMICAL CORPORATION,
By H. S. DOTY,
President.

UNION INDEMNITY COMPANY,
By E. W. MURPHY,
Attorney in Fact.

Pittsburgh, Pa.,
March 10th, 1926.

Assignment of Errors.

Now comes Dovan Chemical Corporation, the plaintiff in the above entitled cause, and files the following assignment of errors upon which it will rely upon the prosecution of the appeal herein from the decree made by this honorable court on the 13th day of February, 1926.

I.

That the Court erred in holding that the Letters Patent in suit No. 1,411,231 are invalid.

II.

That the Court erred in not holding that the said Morris L. Weiss was the first, true, original and sole inventor of the invention described in said Letters Patent No. 1,411,231 and claimed in claims 5, 8, 9 and 12 thereof.

III.

That the Court erred in not holding that the subject-matter described in said Letters Patent No. 1,411,231 constitutes a patentable discovery.

IV.

That the Court erred in not ordering an injunction against the defendant enjoining and restraining it from infringing the patent in suit by making, using, or selling any substituted guanidine and particularly diphenylguanidine for use as a vulcanizing accelerator, or vulcanizing or vulcanized compounds of rubber or similar material combined therewith; and from prac-

ticing the process of treating rubber or similar materials with such vulcanizing accelerator.

V.

That the Court erred in not adjudging and decreeing that the plaintiff is entitled to an accounting against the defendant for profits and damages growing out of the infringement of said Letters Patent No. 1,411,231.

VI.

That the Court erred in holding that the Weiss test dated "2-10-19" was in fact made in "9-10-19"; and that examination under a strong glass plainly shows that "2" was originally "9."

VII.

That the Court erred in holding that the undisputed Weiss tests of February and March, 1919, show no marked superiority of diphenylguanidine over triphenylguanidine.

VIII.

That the Court erred in holding that the Kratz lecture of September 6, 1919, and paper of April, 1920, more fully disclosed the subject-matter of the Weiss Patent No. 1,411,231 than does the patent itself.

IX.

That the Court erred in holding that the table placed by Kratz upon a blackboard gave or correctly gave the comparative powers of diphenylguanidine, triphenylguanidine and other accelerators relatively to aniline as the basis of comparison.

X.

That the Court erred in holding that Weiss in his written applications for employment acknowledged the paper read by Dr. Kratz as showing the superior value of diphenylguanidine as an accelerator.

XI.

That the Court erred in holding that in making such applications for employment Weiss did not claim to have been the original discoverer of diphenylguanidine as an accelerator; or in holding that failure so to assert at such times was prejudicial.

XII.

That the Court erred in giving weight to the alleged test by Baldwin in 1917 and in implying thereby that Weiss was not an original inventor and derived his conception from Baldwin.

XIII.

That the Court erred in rejecting Weiss' tests made in the summer of 1919 because of following certain tests dated in October, 1919, and preceding other tests dated in October, November and December, 1919.

XIV.

That the Court erred in holding that the test-book actually showed only inconclusive tests by Weiss prior to September 6, 1919, and that the tests shown were inconclusive.

XV.

That the Court erred in holding that Weiss' testimony in the instant case shows various contradictions in regard to material matters made in prior statements.

XVI.

That the Court erred in finding as a fact that Morris L. Weiss did not independently discover the efficacy of diphenylguanidine as an accelerator of vulcanization prior to the delivery of the Kratz paper in September 6, 1919.

XVII.

That the Court erred in holding that Kratz had discovered the qualities of, and had used, diphenylguanidine several years prior to the entry of Weiss into the field.

XVIII.

That the Court erred in holding that Kratz in 1916 had established the efficacy of diphenylguanidine as an accelerator of vulcanization by a number of tests.

XIX.

That the Court erred in holding that Kratz in 1916 prepared a table which showed the comparative powers of the accelerators investigated.

XX.

That the Court erred in holding that Kratz in 1917 used diphenylguanidine in the manufacture of 300 tires, being part of a consignment of 1,000 tires sold.

XXI.

That the Court erred in holding that in 1918 Kratz repeated his tests of 1916 with zinc oxide, and that such tests, with other labor necessary, furnished the foundation facts of the paper read on September 6, 1919, and published in April of 1920.

XXII.

That the Court erred in holding that there is documentary evidence which tends to confirm the claim by Kratz of use of diphenylguanidine in tires in 1918.

XXIII.

That the Court erred in holding that the general circumstances make the use of diphenylguanidine as an accelerator by Kratz in tires sold by Falls Rubber Company in 1918 "quite probable."

XXIV.

That the Court erred in holding that Kratz' lecture, or paper, called the attention of rubber manufacturers to the discovery of diphenylguanidine as a rubber accelerator, and did so far more effectively than would have a patent application quietly filed in the Patent Office.

XXV.

That the Court erred in not holding that Kratz' work prior to September 6, 1919, was an abandoned experiment.

XXVI.

That the Court erred in not holding that Weiss was exercising due diligence at and before September 6, 1919.

XXVII.

That the Court erred in holding that diphenylguanidine did not come into public use because no method was known for its cheap manufacture.

XXVIII.

That the Court erred in not adjudging and decreeing that plaintiff recover of defendant the costs and disbursements incurred by the plaintiff, or any costs.

WHEREFORE, this appellant, Dovan Chemical Corporation, prays that the decree of the District Court of the United States for the Western District of Pennsylvania may be reversed in respect to the matters herein complained of, and that a decree be entered pursuant to the prayer of the bill of complaint.

DOVAN CHEMICAL CORPORATION,
By BYRNES, STEBBINS & PARMELEE,
Solicitors.

Dated: March 10th, 1926.

Praecipe on Appeal.

To the Clerk of the United States District Court:

In accordance with the provisions of section (a) under rule No. 75, you are hereby respectfully requested to prepare and forward to the Clerk of the United States Circuit Court of Appeals for the Third Circuit a transcript of the record in the above entitled cause for use in connection with the appeal from the decree of this Court, which said transcript is to be filed in the office of the Clerk of the United States Circuit Court of Appeals for the Third Circuit under the appeal heretofore perfected. Please include in said transcript the following pleadings, proceedings, papers on file and exhibits, to wit:

Docket Entries.
Bill of Complaint.
Answer.
Opening Statements of Counsel.
Plaintiff's Testimony.
Defendant's Testimony.
Rebuttal Testimony.
Surrebuttal Testimony.
Opinion of the District Court.
Final Decree.
Petition for Appeal.
Assignment of Errors.
Order Allowing Appeal.
Bond on Appeal.

Plaintiff's paper exhibits to be reproduced for the transcript:

Plf. Exh. No. 1, Copy of Patent in Suit.

Plf. Exh. No. 2, 2000 X-book (for identification), page 91.

Plf. Exh. No. 4, Contract between Doty & Woodward and Weiss.

Plf. Exh. No. 5, Formula of YME of Weiss.

Plf. Exh. No. 6, X-book 1700 (for identification).

Plf. Exh. No. 7, Page X-1764.

Plf. Exh. No. 8, Page X-1773.

Plf. Exh. No. 9, Page X-1777.

Plf. Exh. No. 10, X-2000 to X-2074.

Plf. Exh. No. 11, Paper from India Rubber World, July, 1921 (marked for identification, page 401).

Plf. Exh. No. 13, Formula of T-8.

Plf. Exh. No. 14, Carlton affidavit.

Plf. Exh. No. 17, Williams' article on Report, Sept. 8, 1919. Philadelphia meeting of American Chemical Society.

Plf. Exh. No. 19, Photostatic copy American Chemical Society Journal, page 221. Preparation of Monophenylguanidine.

Plf. Exh. No. 20, Chart of Tables 1 and 4, Kratz paper.

Plf. Exh. No. 21, Whitby chart showing effect of substitution.

Plf. Exh. No. 22, Chart by Doty.

Plf. Exh. No. 23, India Rubber World of 1919, pages 137 to 140, article by D. F. Cranor.

Plff. Exh. No. 24, Patent to Kratz 1,428,040.

Plf. Exh. No. 25, Rubber Age, February 25, 1921, pages 401 to 403, article by Kratz and Shapiro.

Plf. Exh. No. 26, Paper by W. M. Ames in Journal of Society of Chemical Industry, Apr. 25, 1921, pages 117 T and 125 T.

Plf. Exh. No. 27, India Rubber World of July 1, 1921, p. 744, article relating to Excello.

Plf. Exh. No. 28, Photostat of pages 283 and 284 of Berichte of 1905, Vol. 38, Sec. 53, article by Pellizarri and Cantoni.

Plf. Ex. No. 29, Weber Article.

Plf. Exh. No. 30, Weiss Application, Serial No. 490746.

Plf. Exh. No. 31, Thorpe Article.

Plaintiff's physical exhibits and others which are not to be reproduced, but which are to be treated as physical exhibits:

Plf. Exh. No. 3, Samples of Weiss reports 1919.

Plf. Exh. No. 12, Page from Thorp's dictionary, 1912 edition, defining diaminoguanidine (marked for identification, page 524).

Plf. Exh. No. 15, Tariff Commission report, 1923.

Plf. Exh. No. 16, Tariff Commission report, 1924.

Plf. Exh. No. 18, Graduated bottle of diphenylguanidine.

Defendant's paper exhibits to be reproduced for the transcript:

Dft. Exh. "A," Weiss affidavit.

Dft. Exh. "B," Application of Weiss to National Aniline Company.

Dft. Exh. "C," Application of Weiss to Firestone Company.

Dft. Exh. "E," Paper by Kratz, Flower and Coolidge.

Dft. Exh. "F," Letter from Daniels to Stevens.

Dft. Exh. "G," Dovan Chemical Corporation Circular.

Dft. Exh. "H," File Wrapper of patent in suit.

Dft. Exh. "K," Copy of Chemical & Metallurgical Engineering for Oct. 1, 1919.

Dft. Exh. "L," Pages from Metallurgical & Chemical Engineering, Sept. 1, 1916.

Dft. Exh. "M," Copy of pages 782 to 789 of Journal of Society of Chemical Industry for July 31, 1917.

Dft. Exh. "N," Article "The Rubber World" for May 1, 1921, pages 572 and 573.

Dft. Exh. "O," Translation of article in French magazine.

Dft. Exh. "P," Kratz cards.

Dft. Exh. "Q," Second group of Kratz cards.

Dft. Exh. "R," Norwalk report by Dr. Kratz.

Dft. Exh. "S," Laboratory Sheet—Dr. Kratz.

Dft. Exh. "T," Three sheets identified by Kratz.

Dft. Exh. "U," Kratz test sheet.

Dft. Exh. "X," Cards containing formula for above tubes.

Dft. Exh. "AA," Photograph of page of X-book.

Dft. Exh. "BB," Photograph of page of X-book.

Dft. Exh. "CC," Photograph of page of X-book.

Dft. Exh. "DD," Unmutilated print of Herring.

Dft. Exh. "DD-1," Two cards attached to above print.

Dft. Exh. "GG," Records of Bridgwater Tests.

Dft. Exh. "HH," Test sheets of Witness Bridgwater.

Dft. Exh. "II," Test sheets of Witness Bridgwater.

Dft. Exh. "MM," Test sheets of Witness Bridgwater.

Dft. Exh. "NN," Chart showing formula for disubstituted guanidine.

Dft. Exh. "OO," Hoffman patent No. 1,126,469.

Dft. Exh. "PP," Article by Peachey.

Dft. Exh. "RR," Article by Twiss and Brazier.

Dft. Exh. "SS," Sheet recording tests of Sanderson.

Dft. Exh. "UU," Daniels deposition in Dovan vs. National.

Dft. Exh. "QQ," Weiss patent 1,422,506.

Dft. Exh. "QQ[1]," Sheet of chemical formula.

Dft. Exh. "WW," Carlton affidavit.

Defendant's physical exhibits and others which are not to be reproduced, but which are to be treated as physical exhibits:

Dft. Exh. "D," Weiss brief in Interference proceeding.

Dft. Exh. "I," Stipulation covering items of proof.

Dft. Exh. "V," Inner tube made at Falls Rubber Co. (With D. P. G.)

Dft. Exh. "W," Inner tube made at Falls Rubber Co. (without D. P. G.).

Dft. Exh. "EE," Cut-out prints by Herring.

Dft. Exh. "FF," Barrows letter (offered and withdrawn).

Dft. Exh. "QQ[2]," Article by King, Sept. 1, 1916 (same as Ex. "L").

Dft. Exh. "TT," Rubber slabs of Sanderson.

Dft. Exh. "VV", Record of Scott vs. Weiss vs. Heuser.

Dft. Exh. "YY," Bottle of white powder.
Copy of this Praecipe.

BYRNES, STEBBINS & PARMELEE,
Solicitors for Dovan Chemical Corporation.

Service of a copy of the above praecipe is acknowledged this 13th day of March, 1926.

WINTER, BROWN & CRITCHLOW,
Solicitors for Corona Cord Tire Company.

Certificate.

I, J. Wood Clark, Clerk of the District Court of the United States, for the Western District of Pennsylvania, do hereby certify that the annexed and foregoing pages contain a true and correct copy of the record on appeal in the above entitled case, so full and entire as the same remains of record and on file in my office, in the City of Pittsburgh, in said District.

IN TESTIMONY WHEREOF, I have hereunto signed my name and affixed the seal of the said Court, at Pittsburgh, this ..... day of ....., A. D. 1926.

J. WOOD CLARK,
Clerk.

Vol. II

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1927

No. 182

CORONA CORD TIRE COMPANY, PETITIONER,

vs.

DOVAN CHEMICAL CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT

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PETITION FOR CERTIORARI FILED FEBRUARY 21, 1927

CERTIORARI GRANTED APRIL 11, 1927

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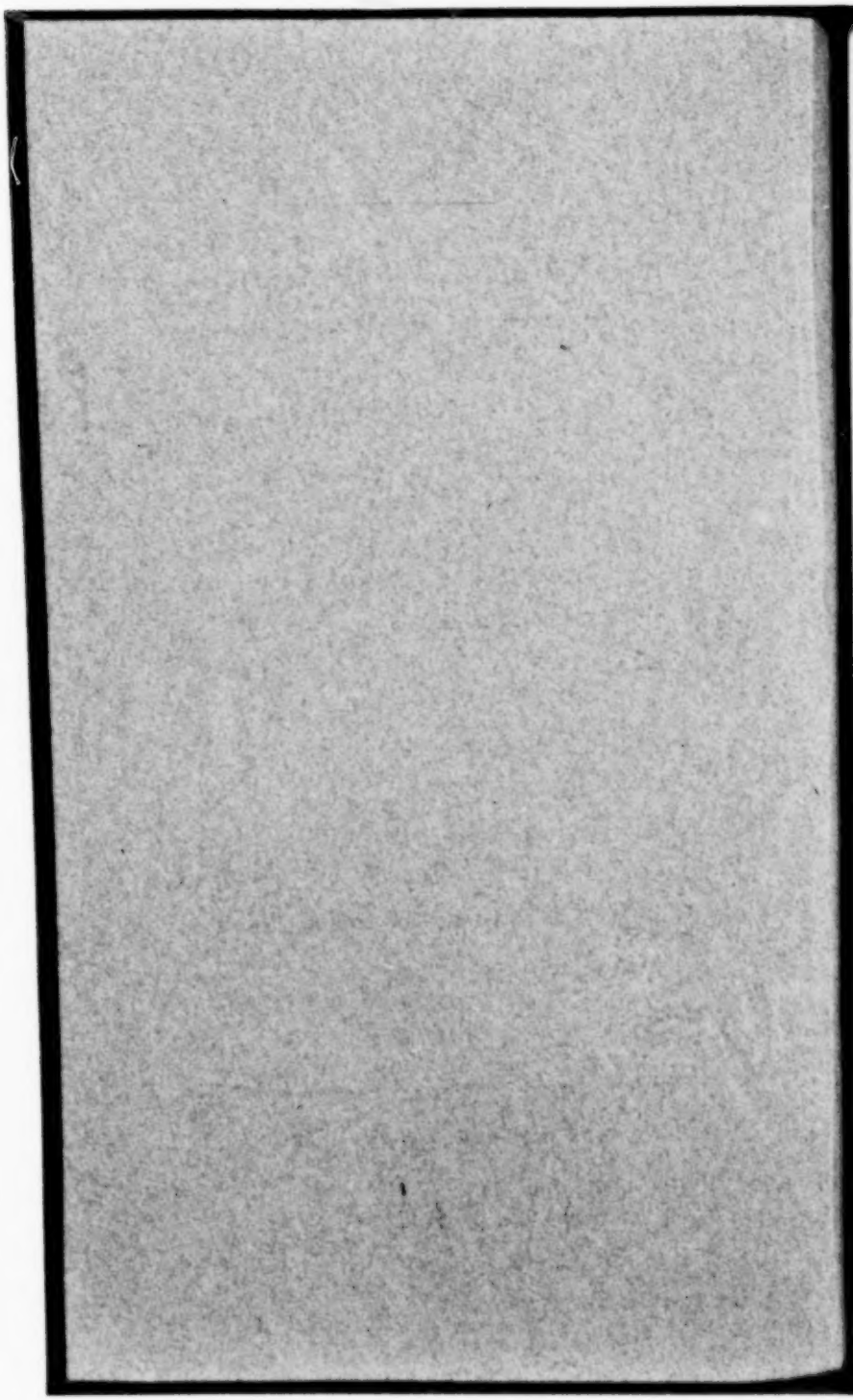

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SUPREME COURT OF THE UNITED STATES

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JUDD & DETWEILER (INC.), PRINTERS, WASHINGTON, D. C., SEPTEMBER 16, 1927

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UNITED STATES PATENT OFFICE.

MORRIS L. WEISS, OF BROOKLYN, NEW YORK, ASSIGNOR TO DOVAN CHEMICAL CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

VULCANIZATION ACCELERATOR.

1,411,231. Specification of Letters Patent. Patented Mar. 28, 1922.

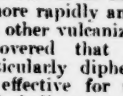
No Drawing. Application filed November 12, 1921. Serial No. 514,727

To all whom it may concern:

Be it known that I, MORRIS L. WEISS, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Vulcanization Accelerators, of which the following is a full, clear, concise, and exact description.

The object of my invention is to improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose. It is known that when certain organic substances are added to the rubber mix during the compounding, a catalytic or similar action is produced which causes the rubber or similar gum to unite or react more rapidly and thoroughly with sulphur or other vulcanizing agents.

I have discovered that disubstituted guanidines particularly diphenylguanidine are particularly effective for this purpose. This substance is indicated by the formula



I am aware that disubstituted guanidines have been produced by laboratory methods and have been known to chemists for many years beginning about the year 1848 with the work of A. W. Hoffman (An. Chem. Pharm. 67–129), but down to time of my researches in accelerators of this type, it was apparently not known that di-substituted guanidines were efficacious or useful as accelerators in vulcanizing, nor that this substance could be produced in sufficiently large quantities in a substantially pure form, or at a sufficiently low cost to be available for this purpose.

I am aware that triphenylguanidine has been suggested, and probably used to some extent, as an accelerator in the vulcanization of rubber, but the use of diphenylguanidine for that purpose appears to have been unknown prior to my researches on this substance.

I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but results in a final product much superior in texture, strength, durability and aging qualities over that when the triphenylguanidine is used. A greatly improved product also results when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards elasticity, aging qualities and freedom from "bloom." In these and similar instances, it has been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressures than those commonly employed.

In my prior application Serial No. 482,143 filed July 2, 1921, I have described and claimed a process for producing and purifying diphenylguanidine in commercial quantities, and have therein given a résumé of the historical development of the methods of producing the same.

As set forth in said application, I, at present, prefer to produce my improved accelerator by desulphurizing thiocarbanilide by the action of a metallic oxide, such as lead oxide, zinc oxide, etc., in an alcoholic solution of an ammonium salt, such as ammonium nitrate.

The present patent application therefore relates to the vulcanization of rubber or similar substances, in which disubstituted guanidines are employed as the accelerating agent or catalyzer, and particularly diphenylguanidine.

The method of carrying out my invention, which I at present deem preferable, may be illustrated by the following example:

The rubber may be compounded in the following proportions: 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, 1 part by weight of diphenylguanidine.

These are mixed together in any suitable way, such as by milling, and then vulcanized or cured in the usual molds or otherwise under heat corresponding to a steam pressure of about 40 lbs. per square inch. This vulcanizing temperature should be continued until the compound is suitably vulcanized, which requires from 10 to 20

Plaintiff's Exhibit No. 1

1

minutes depending upon the shape and size of the articles being vulcanized.

It will therefore be appreciated that when using the accelerator according to my invention the vulcanization is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness without danger of over-curing the softer or more elastic parts. I have found moreover that diphenylguanidine does not need zinc oxide to shorten the time of cure. I however prefer to use zinc oxide on account of its effects on the physical properties of the product.

Having thus described this example of my invention and the method of using the same, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, etc., indicated, for various changes may be made without departing from the essential features of my invention as set forth in the accompanying claims.

What I claim and desire to protect by Letters Patent is:

1. The process of treating rubber or similar materials, which comprises combining with the rubber compound a di-substituted guanidine.

2. The process of treating rubber or similar materials which comprises combining with rubber compound a di-substituted guanidine comprising two phenyl radicles or groups.

3. The process of treating rubber or similar materials which comprises combining with the rubber compound an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

4. The process of treating rubber or similar materials which comprises combining with the rubber compound diphenylguanidine.

5. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine accelerator.

6. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine comprising two phenyl radicles or groups.

7. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

8. The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine.

9. A vulcanizing compound of rubber or similar material combined with a vulcanizing agent and a di-substituted guanidine.

10. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and di-substituted guanidine comprising two phenyl radicles or groups.

11. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine.

Signed at New York, N. Y., November 10th, 1921.

MORRIS L. WEISS.

PLAINTIFF'S EXHIBIT No. 4

Memorandum of agreement made this thirteenth day of April between M. L. Weiss of New York City, party of the first part, and Van Lear Woodward of New Brighton, N. Y., and H. S. Doty of Passaic, N. J., parties of the second part.

In consideration of a salary of * * * dollars (* * *) per month, to be paid the party of the first part by the parties of the second part, commencing April 15, 1920, said party of the first part agrees to make and produce, in quarters and with equipment supplied by the parties of the second part, a certain chemical known as Diphenylguanidine, of a quality similar to sample handed the parties of the second part by the party of the first part and labeled A-April 13, 1920, which material is to be used as an accelerator by the rubber industry.

Parties of the second part agree to use their best endeavors to properly put this commodity on the market.

Parties of the second part further agree to pay to the party of the first part the sum of * * * cents (* * *) per pound on all of this material sold.

Party of the first part agrees to deposit with the parties of the second part, and receipt of same is hereby acknowledged, the formula and process for the manufacture of said Diphenylguanidine, as a protection to the parties of the second part in return for their providing the party of the first part with the equipment to produce.

Party of the first part agrees to give the parties of the second part first option upon any other chemicals that he can now or hereafter produce on a royalty basis to be arranged at that time.

Party of the first part agrees that the parties of the second part may at their option at any time during the life of this agreement, or any renewals thereto, form a corporation to produce, manufacture and sell said Diphenylguanidine, provided said corporation carriers out all the clauses of this agreement.

This agreement to be in force for a period of six months from date and to be automatically renewed for like periods

of six months, unless either party advises the other party in writing thirty days previous to the expiration of this agreement, or any renewals thereto, his or their intention not to renew.

In witness whereto said parties have hereunto set their hands and seals executing this agreement in triplicate this thirteenth day of April, 1920.

M. L. Weiss, Van Lear Woodward, H. S. Doty.

Witness: J. H. McCoy, H. W. Loving, Addison H. Brown.

#0

MYE

Packer

Bl. Lieps	15
Batanga	40
Mam	11
Lane	2
Ind	3
Zane	24½
Crowte	4 (Diffends 1)
Quertes	½
	100

Plf's Exhibit No. 5
Mye Formula
Oct 9/25
Pack.

cure 30/35
clong 14½
Tenale 25 30
set ½

#6 NUMBER X 1764 MADE FOR Imited Norwalk Tire P. O.

		A	B	C	D	E	F	G	H
S. Sheets	79	70	70	79	87½				
Coarse									
Canelle									
Guayule									
Methe	15	15	10						
Zinger		8½	13	13					
A									
B									
C									
D									
F									
G									
Difficile (Pine)					¾				
Al Flake									
Lime									
Litharge									
Sulphur	3	3½	4	4	3½				
White Lead									
Zinc	3	3	3	2					
Magnesia Metric				2	1 7½				
Total	100	100	100	100					
Sp. Grav. Cost and Prices	Floats 68.47 1.60 54.9	5191 1.60 53.41	5191 1.60 5791						
	Glenn Rub	Glenn Rub	Glenn Rub						
Cure	65/754	67/754	65/754	67/754					
Stretch									
Strength									
Set									
Color									
Date	7/8/19	7/16/19	7/16/19	8/6/19	7/20/19				

Remarks Norwalk Tests: Nr 20-14 c Sens. 2670-2630 = Set ¼-3/16

Plaintiff's Exhibit No. 7

3

723

NUMBER X 1773 MADE FOR Red Tube P O _____

		A	B	C	D	E	F	G	H
Sheets	91½	91	90½	90					
A									
B									
C									
D									
F									
G									
		½	3/8	3/4					
Plate									
	2½	2½	2½	3½					
Land									
	2	2	4¼	4¼					
Rod	2	2							
	2	2	2	4½					
			2	81					
			139/192						
			18						
			1460						
			18						
	Paid →		→	→					
	11-1-19 →		12-5-19	12-11-19					

Plaintiff's Exhibti No. 8

721

NUMBER X #3 1777 MADE FOR Inner Tube Spring Cement P O _____

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Caucho									
Guayule									
55	60								
A									
B									
C									
D									
P									
U									
Difdy Gum	10 1/4								
Al Flake									
Lime									
Litharge									
Sulphur	1								
White Lead									
Zinc	11								
Coloring	17								
Carb Bis	1/4								
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

7

Plaintiff's Exhibit No. 9

COPY BOUND CLOS

Plaintiff's Exhibit No. 10.

("X" Book pages X 2000 to X 2074)
Including an enlargement of a portion of page 2034

IN CENTER

NUMBER X 2210 MADE FOR Action of organic accelerators P. O.

		A	B	C	D	E	F	G	H
S. Sulfur	50	50	50	50	50	50	50	50	
Cumar									
Cumbo									
Captax							E		
Cumate							2		
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur	3	3	3	3	3	3	3	3	
White Lead									
Zinc	47	47	47	47	47	47	47	47	
Aniline Oil		2							
4-Dimethylaniline			1					½	
Diphenylguanidine				2				1½	
Diphenylamine					1				
Naphthylamine						1			
Total	100.00	102.00	101.00	102.00	101.00	101.00	102.00	102.00	
Sp. Grav. Cure and Press									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X MADE FOR P O

		A	B	C	D	E	F	G	H
Cure . .	35/40	34/40	40/40	40/40	40/40	40/40	40/40		
2"h.t. .	15½	15	14½	15	15	15½	15		
T. St. . .	1350	3020	3230	3400	1170	2095	2100		
Set . .	5/16	3/16	3/8	7/16	5/16	1/4	5/16		
Cure . .	120/40	105/40	69/40	54/40	120/40	120/40	48/40		
2"h.t. .	15	14	14½	15½	15	15	13¾		
T. St. . .	1900	2148	2185	3340	2190	2635	2215		
Set . . .	1/4	5/16	5/16	1/2	1/4	3/8	1/4		
Cure . . .	129/40		99/40	49/40					
2"h.t. .	14¾		14	15					
T. St. . .	2135		2140	3265					
Set . . .	1/4		1/4	1/2					
Cure . . .	109/40								
2"h.t. .	14¾								
T. St. . .	2135								
Set . . .	5/16								

Remarks -

I 2000 - Standard Compound. O.K.

I 2000 B - Nitrosodimethylaniline HCl - From Rohland Anilines Co - Chicago Ill.
Yellow crystalline powder when fresh but deliquesces to black mush in air. Colors everything it comes in contact with yellow. Both Sym and Unsym are compounded. After cure blooms out yellow. After 3 days standing on batch accelerator properties seemed to have practically gone. When fresh, is a fairly good accelerator. Not practical for works.

I 2000 A - Aniline oil (pure) Too fast scorching powder.

I 2000 C - Diphenylguanidine - Very good accelerator. For making see Gattermann Pg 205 also Met. and Chem Engineering. Sept 15'16.

I 2000 D - Diphenylamine -

I 2000 E - Naphthylamine -

I 2000 F - Cumate

NUMBER X 2001 MADE FOR ACTION OF ORGANIC ACCELERATORS P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	60	60	60	
Coarse									
Cumar									
Gumyale									
Nitronaphalene						1			
Hexamethylenetetramine							1		
$C_6H_5NCH_2$								1	
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur	3	3	3	3	3	3	3	3	
White Lead	47	47	47	47	47	47	47	47	
Zinc									
Salicylic Acid	1/2								
Guanidine		1.	2						
Phenylhydrazine				1					
Phenylenediamine					1				
Aldehyde Ammonia			1/2						
Total	100.5	101.00	101.50	101.00	101.00	101.00	101.00	101.00	
Sp. Grav. Cost and Price									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X _____ MADE FOR _____ P. O. _____

		A	B	C	D	E	F	G	H
Cure	40/40	40/40	59/40	Sponge	40/40	40/40	39/40	39/40	
2"h.@	15"	15"	13 1/4		No	Accel.	14	15	
T.St.	2115	2115	3150		Acceleration	Noted	3230	3510	
Set	3/16	3/16	5/16				7/16	1/4	
Cure	75/40	75/40	129/40				75/40	69/40	
2"h.@	14 1/2	14 1/2	13				13 1/2	15 1/2	
T.St.	3160	3160	2720				3580	3240	
Set	7/16	7/16	7/16				9/16	1/4	
Cure	129/40	129/40					59/40		
2"h.@	19 3/4	19 3/4					19		
T.St.	2165	2165					3181		
Set	1/2	1/2					3/4		
Cure							49/40		
2"h.@							19 1/2		
T.St.							2125		
Set							1/4		
Cure							59/40		
2"h.@							15 1/2		
T.St.							2690		
Set							5/16		
Cure							69/40		
2"h.@							15		
T.St.							2990		
Set							3/8		
Cure							79/40		
2"h.@							14 1/2		
T.St.							3130		
Set							3/8		

REMARKS:-

X2001 - NO ACCELERATION

X2001A - QUINOLINE - LIQUID BOILING AT 240 - SOME ACCELERATION.

X2001B - ALDEHYDE AMMONIA — YELLOW CRYS. POWDER - ODER STRONG OF NH_3. ACCELERATION VERY GOOD.

X2001C - PHENYLHYDROZINE - N.G.

X2001D - PHENYLENE DIAMINE - NO ACCELERATION -

X2001E - NITRONAPHALENE - " " "

X2001F - HEXAMETHYLENE TETRAMINE - NOT QUITE AS GOOD AS X2000E - DOES NOT ACCEL. IN SHIDDY -

X2001G - $C_6H_5NCH_2$ - PRODUCT OF ANILINE + FORMALDEHYDE - N.G.

NUMBER X 2002 MADE FOR ACTION OF ORGANIC ACCELERATORS P.O.

		A	B	C	D	E	F	G	H
R. Sheets	50	50							
Coarse									
Caucho									
Guayule									
Product A	1								
DINITROBENZOL		2		6	3	3		3	
						50			
A									
B									
C									93
D									
F				97	97		87	88	
G						44			
W									
Al Flake									
Lime							1	1	1
Litharge		10			3	3	9	8	9
Sulphur	3						4		2
White Lead									
Zinc	47	88							
Total	101.00	100.00		103	103	100	100	100	100
Sp. Grav. Cost and Prices									
Cure		60/70							30/40
Stretch		FAIR CURE		Test runs on shoulders - Dinitrobenzol unsatisfactory					11
Strength				S. in curing. Results showed this rate relcatively					100
Set				about the same as S. - No advantage over					3/8
Color				S. as far as physical properties.					Bl.
Date									3/17-17

Remarks "D" in A2002H treated with 5% Beta Naphthol and heated 4 hrs at 30 lbs in heater.
"D" used in A2002H1 same as in A2002H but washed with hot H_2O.

NUMBER X MADE FOR P O

		A	B	C	D	E	F	G	H
R. Sheets	60/40								
Coarse	15/4								
Caucho	3025								
Guayule	75								
	70/40								
	15 3/4								
	2500								
A	5/16								
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2003 MADE FOR ORGANIC ACCELERATION P. O.

		A	B	C	D	E	F	G	H
S. Sheets	60	50	60	50	50	10	10	60	50
Coarse									
Caucho									
Guayule									
DINITRONAPHTHALENE	1								
DINITROBENZOL		2							
BENZIDINE			1						
A									
B									
C									
D						57	57		
F									
G									
PICRIC PHENOL				1					
BETA NAPHTHOL					1				
P. PHENYL						1		1	
CROMITE							1		1
Al Flake									
Lime									
Litharge	10	10				10	10	10	10
Sulpher			3	3	3	2	2	3	3
White Lead									
Zinc	38	38	47	47	47	20	20	37	37
Total	100	100	101.00	101.00	101.00	100	20 0	101.00	101.00
Sp. Grav. Cost and Prices						Lampamin	P. Phenyl Chromite	Lampamin	P. Phenyl Chromite
Cure	64/100 to 120/140	80/10	64/40	60/40	64/40				
Stretch	No Cure	Fair Cure	Soft →	Way	Lampamin to 120/40				
Strength		But Test	Undercured	Undercured	very Undercured				
Set		Way Down	No Accln.	No Accln.	N.B.				
Color									
Date			2/9-17	2/8/17	2/14-17				
Remarks									

NUMBER X MADE FOR P. O.

	A	B	C	D	E	F	G	H
S. Sheets					39/40	39/40	49/40	49/40
Coarse					10 3/4	11	11 1/2	15 1/2
Caucho					860	650	3020	3920
Guayule					1/4	5/8	7/16	7/16
					37/40	39/40	57/40	59/40
					7 3/4	10	14 3/4	15
					675	685	2560	3035
A					1/5	1/5	3/8	1/2
B					49/40	49/40	60/40	60/40
C					10 1/4	12 1/2	14	15
D					775	770	2540	2965
F					1/4	7/16	7/16	7/16
G								
Al Flake								
Lime								
Litharge								
Sulpher								
White Lead								
Zinc								
Total								
Sp. Grav. Cost and Prices								
Cure								
Stretch								
Strength								
Set								
Color								
Date								
Remarks								

X 2004 MADE FOR ACTION OF ORGANIC ACCELERATORS (See X2002) SHOODY P O.

		A	B	C	D	E	F	G	H
				50					
Coarse									
Cascho									
Guayule									
Br. Crepe	4	4			4	4			
A									
B									
C									
D	60	60			60	60			
F									
G									
Br. Blk. Treads	15	15			15	15			
M.R.X.	4	4			4	4			
Inertia	4	4							
Al Flake									
Lime	1 1/2	1 1/2			1.5	1.5			
Litharge					5	7.			
Sulphur	1 1/2	1 1/2		3	1.5	1.5			
White Lead									
Zinc				47					
Fossil Flour	7	10			7.	7.			
P. Phenyl C_6H_5	3				2.				
Total	100	100			100	100			
Sp. Grav. Cost and Press									
	NEEL	NEEL			SAA X1	SAA X1			
Cure	30/75	30/75			30/40	30/40			
Stretch	POROUS				8 1/4	8 1/2			
Strength	X2004 Cured O.K.				625	605			
Set	X2004A Cured O.K.				1/4	1/4			
Color	Little difference in tire stock as to cure								
Date					3-23-42	3-23-42			

Remarks

Remarks of X2001 CHP

NUMBER X MADE FOR P O (10)

		A	B	C	D	E	F	G	H
S. Sheets					20/30	30/30			
Coarse					8 1/4	8			
Cascho					570	610			
Guayule					1/4	1/4			
					29/30	30/30			
					8 1/4	8			
					570	646			
A					5/6	1/4			
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2005 MADE FOR Action Of Organic Accel. P. O. on Shoddies

	(2004C)	A	B	C	D	E	F	G	H	I
S. Sheets	60									
Cotton										
Canvas										
Oxygrain										
Dynamyl Guanidine	1									
D. Shoddy		93	93			93				
Z. Shoddy				93	93		93			
C Shoddy								70	70	70
anilyldiphenyl guanidine		1		1	-					
Diphenyl Guanidine			1		1			3		
Br. Crepe								5	5	5
Al Flake										
Lime		1	1	1	1	1	1	1	1	1
Litharge		1	1	1	1	2	2			
Sulphur	3	4	4	4	4	4	4	4	4	4
White Lead										
Zinc	47							~~17~~		
Barytes								17	20	18
Phenyl-beta-naphthylamine										2
Total	~101.00	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices										
Cure	144/40	34/40	40/40	34/40	30/40	34/40	34/40	34/40	28/35	35/35	42/30
Stretch	N.G.	7	7/4	7/4	7	7	6 1/2	6	6 1/4	7 1/2	11	11 1/4	9 1/2
Strength		360	380	380	380	340	345	395	395	390	430	510	528	618	690
Set		3/32	4/32	3/32	3/32	4/32	5/32	5/32	7/16	4/32	9/32	9/32	13/32	4/4	9/4
Color															
Date	4/22	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	2-21-19	2-21-19	2-21-19
Remarks										Less set, stretch, cure	Stretch, set	

NUMBER X 2006 MADE FOR action of Organic accel. on Shoddies P. O.

	A	B	C	D	E	F	G	H
S. Sheets								
Cotton								
Canvas								
Oxygrain								
C. Shoddy	93	93	93	95.5	95	93	98	70
Cromite		3						
Diphenylguanidine								
Br. Crepe		3						5
B								
C								
D								
F								
G								
anilyldiphenylguanidine			3					
Phenyl-beta-naphthylamine				25	25			
P Phenylenediamine					.5			
Hexyldecanol						3		
Al Flake								
Lime	1	1	1	1.5	1.5	1	1	1
Litharge	3							
Sulphur	3	3	3	3	3	3	3	4
White Lead								
Zinc							3	
Diphenylguanidine							2	2
Barytes								18
Total	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices								
Cure	30/40	30/40	35/40	29/40	20/40	27/30	Too much Accelerator		15/30
Stretch	8 3/4	8 1/4	9 1/2	12 1/4	9 1/2	8 1/2			10 1/4
Strength	430	405	530	415	450	670			720
Set	3/4	5/16	9/8	1/2	5/16	3/16			5/8
Color									
Date	July 26-18	July 26-18	July 26-18	July 26-18	July 26-18	July 26-18			2-21-19
Remarks							Over cured Too much Accelerator		Compared with 2005 A

NUMBER X 2006 MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Sheets	50	50	60						
Coarse									
Caucho									
Guayule									
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge	10	8	8						
Sulphur	3	3	3						
White Lead									
Zinc	37	37	37						
HERA.		2							
EXCELSIOR Kauba New York City			2						
Total	100	100	100						
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X MADE FOR P O

		A	B	C	D	E	F	G	H
S. Sheets	42/40	44/40	40/40						
Coarse	14 3/4	15"	15"						
Caucho	2740	2770	2145						
Guayule	3/8	3/4	3/8						
	34/40	34/40	38/40						
	15 3/4	14	15 1/2						
	2480	2255	3090						
A	7/8	9/32	1/4						
B	34/40	34/40	40/40						
C	15 1/2	15"	15 3/4						
D	2000	2000	2250						
F	5/16	1/4	5/16						
G	49/50	49/50	49/50						
	15 1/2	15 1/2	15 1/2						
	2390	2400	2600						
	5/16	9/32	1/4						
	30/30	30/30	30/30						
Al Flake	17	15 1/2	16						
Lime	2000	1920	2300						
Litharge	3/8	9/32	1/4						
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

COMPARISON OF

NUMBER X 1007 MADE FOR ACTION OF ACCELERATORS P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	10	10	10	50	50	50			
Coarse									
Quicks									
Oxzyole									
HEXA (NEW)	1			1					
P-PHENYLENE		1			1				
A									
B									
C									
D									
F									
G									
S	57	57	57						
Al Flake									
Lime									
Litharge	10	10	11	10	10	10			
Sulphur	2	2	2	3	3	3			
White Lead									
Zinc	20	20	20	37	37	37			
Total	100	100	100	101	101	100			
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color	Bl.	Bl.	Bl.						
Date	3/24-17	3/24-17	3/24-17	3/26-17	3/26-17	3/26-17			
Remarks									

NUMBER X _____ MADE FOR _____ P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	30/40	30/40	30/40	30/40	30/40	30/40			
Coarse	6 3/4	6 1/2	7 3/4	15	18 3/4	15 1/2			
Quicks	985	635	692	2195	2450	1950			
Oxzyole	3/16	1/4	3/16	5/16	1/4	1/4			
	25/40	25/40	25/40	45/40	45/40	45/40			
	6 3/4	6 1/2	7	15	18 3/4	15			
	968	668	718	2610	2170	2795			
A	5/16	3/16	3/8	3/8	5/16	3/8			
B	35/40	35/40	35/40	55/40	55/40	55/40			
C	7 1/4	7	5	17 1/2	17	15			
D	616	612	660	3090	3690	2835			
F	7/16	3/8	1/2	1/2	3/4	3/8			
G	35/40	35/40	35/40	65/40	69/40	65/40			
	6	5 3/4	6 1/2	15 1/4	18 1/2	15 1/4			
	910	625	617	3056	3950	3025			
	5/16	3/16	5/16	3/8	3/4	1/2			
	49/40	49/40	49/40	79/40	79/40	79/40			
Al Flake	6 3/4	6 1/4	7 1/2	15 1/4	14	14 1/2			
Lime	746	670	693	2550	2650	2535			
Litharge	3/8	1/4	3/8	1/2	1/4	7/16			
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X 2008 MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Caucho									
Guayule									
A									
B									
C									
D Sht.	~~93~~	93		93					
F									
G									
USAM	93		93						
Al Flake									
Lime	1	1	1	1					
Litharge			2	2					
Sulphur	4	4	4	4					
White Lead									
Zinc									
HEXA	2	2							
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Sheets	30/40	34/40	34/40	34/40					
Coarse	9	7 5/8	8 3/4	7 1/2					
Caucho	950	650	970	570					
Guayule	3/16	1/16	3/16	1/16					
	34/40	34/40	30/40	34/40					
	10 1/2	7 1/2	12 1/4	9 3/4					
	1180	570	1250	640					
A	11/32	1/16	3/8	1/8					
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X 2009 MADE FOR C_6H_5 P. O.

		A	B	C	D	E	F	G	H
S. Sheets	60	60							
Coarse									
Cassia									
Guayule									
Rx Crepe			20	20					
A									
B									
C									
D Sfm			40	40					
F									
G									
Al Flake									
Lime	2	2							
Litharge			10	12					
Sulphur	4	4	3	3					
White Lead									
Zinc	12	12	17	17					
BARYTES	20	22	10	10					
C_6H_5	2		2						
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date	4/20-17	4/20-17	4/21-17	4/21-17					

Remarks

NUMBER X MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Sheets	64/40	64/40	3 9/40	3 9/40					
Coarse	17	17	11 3/4	11					
Cassia	1500	1605	1333	1352					
Guayule	4/4	7/8	1/4	7/16					
	5 3/40	5 3/40							
	16 1/2	16							
	2000	1410							
A	5/16	3/8							
B	7 9/40	7 9/40							
C	17 1/2	17							
D	2810	2090							
F	9/32	3/4							
G	6 9/40	6 9/40							
LOOKS	16	17							
GOOD	2750	1305							
	7/8	3/8							
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total									
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2010 MADE FOR Excelsior From K&B P. O.

		A	B	C	D	E	F	G	H
S. Sheets	50	60	40	40					
Coarse									
Canabo									
Gunyule									
Br Crepe									15
Batanga									40
U Sam									11
A									
B									
C									
D									
F									
G									
MRX.			5	10					
Al Flake									
Lime									2
Litharge									
Sulphur	3	3	3	3					3
White Lead									
Zinc	45	47	47	47					27½
Excelsior	2		2						
Trifon									1
Quartz									½
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure									40/40
Stretch									14
Strength									1605
Set									7/16
Color									
Date	5-7-17	5-7-17							Sept 6-19
Remarks									

NUMBER X 2010 MADE FOR Accelerator and Kodak P. O.

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Canabo									
Gunyule									
Batanga					12	12	40	40	40
U Sam					70	70	11	11	11
A									
B									
C									
D Shelby	93	93	70	70					
F									
G									
Br. Crepe			5	5			15	15	
									15
Thongthrowed Al Flake		1	1						
Lime	1			1	1		2		2
Litharge	3	3							
Sulphur	3	3	4	4	3	3	3	3	3
White Lead									
Zinc							26½	28½	27½
Bayfield			20	20					
Delhi					13	13			
Trifon					1	2	2	2	
Quartz							½	½	½
Diffendorf									
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure	30/40	30/30	30/30	35/35	35/35	35/35	40/40	40/40	30/35
Stretch	7¾	9	8¼	8½	14	14	13¾	13¾	14-16
Strength	510	575	585	675	1525	1620	2105	2075	2530
Set	1/4	7/16	7/8	9/16	13/16	13/16	1/2	7/16	1/2
Color									
Date	3-4-19	3-4-19	3-5-19	3-5-19	3-5-19	3-5-19	3-21-19	3-29-19	3-29-19
Remarks									

NUMBER X 2011 MADE FOR X-1708 A X-1708 B X-1708 C P O

		A	B	C	D	E	F	G	H
B. Sheets	50	50	39.625						
Coarse Para				23.25	32.	35.75	27.5	27.5	27.5
Caoba			5.	10.	10.	10.	10.	10.	10.
Guayule									
Brown Crepe			36.	36.	36	36.	36.	36.	36.
Matalena			16.625	12.	17.	13.	12.	12.	12.
Juertia							10.		
V-55 A		1							
B									
C									
D									
F									
G								10.	
Lithophone									10.
Barytes									
Al Flake									
Lime									
Litharge									
Sulphur	4	4	4.25	4.25	.5	5.25	4.5	4.5	4.5
White Lead									
Zinc	44	43	14.5	14.5					
MgO	2	2							
Rubber	50 %	50%	81%	81.07%	94.745%	94.555%	85.32%	85.32%	85.32%
Sul to Rub.	8 %	8%	5.25%	5.24%	5.28%	5.55%	5.28%	5.28%	5.28%
Accel to Rub.		2%	0.368%	0.222%	0.27%	0.206%	0.211%	0.211%	0.211%
Coef of Fric	240%		2.117	2.47	3736	3441		4.00%	3.02%
Total	100	100	100	100	100.	100	100	100	100
Sp. Grav. Cost and Prices	1.55		1.09	1.09	Floating	Floating			
Cure	80@40'		50@47'	50@47'	65@47'	65@47'	65@47.2h	65@47'	65@47'
Stretch	16		630 %	1974 %	20		Undercured	20	20
Strength	3205		2605	3260, 3290			Stiff-weak	3138	2448
Set	18/32						No good	3/16	3/16
Color	White		grey	grey	Black		Low tensile	grey	Black
Date	6-13-17		6-16-17	6-14-17	6-14-17		6-14-17	6-24-17	6-24-17
Remarks	X	X	X	X	X	X	X	X	X

NUMBER X 2012 MADE FOR P O

		A	B	C	D	E	F	G	H
B. Sheets		9.5					50		
Coarse Para	29.25	16.	31	27.69	23.05	22.34		28	26.27
Caoba	10.	17.	10	10.	10.	10.		10	10.
Guayule									
Brown Crepe	36.	10.	35	35.	16.	13.		35	36.
Matalena	15.		19	22.06	19.33	18.30		22	18.
W. R. X.	5.					5			5.
A									
B									
C									
D									
F									
Paragol					12.	12.			
Guayule		9.							
Ceylon 1st		15.			15.	15.			
Cromite		2.5							
Black Sub		12					1		
V-52 Al Flake									
Lime		1.							
Litharge									
Sulphur	4.75	6.	5	5.25	4.62	4.36	4	5	4.75
White Lead									
Zinc							43		
Magnesia		2.					2		
Rubber	90.525%	78.52%	94.715%	94.419%	83.09%	78.365%	50 %	94.67%	90%
Sul to Rub.	5.26%	7.84%	5.28%	5.56%	5.56%	5.56%	8%	5.28%	6.26%
Accel to Rub	0.244%	3.27%	0.30%	0.35%	0.35%	0.35%	2%	0.348%	0.86%
Coef of Fric	3.79	4	4.12	3.24	F.S. 1.24%	F.S. 1.10%			
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices	1.21	1.21		1.21	1.21	1.21	1.53	0.958	1.21
Cure	45@47' 55@47'	60@55@47.2h	55@47'	65@47'	55@47'	55@47'	90@4h	55@47'	55@47'
Stretch	20	Both weak undercured	Undercured	18 %	Undercured	Undercured	14	20	21
Strength	2155		2170	2575	Stiff-weak	Stiff-weak	3239	2500	1976
Set	3/16		1/32	1/16	No elong.	No elong.	5/32	1/8	1/4
Color	Black		Black						Black
Date	6-26-17		6-26-17	6-26-17	7-6-17	7-6-17	7-6-17	7-9-17	7-10-17
Remarks	X	X	X	X	X	X	X	X	X 20

NUMBER X 2013 MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Shorts								50	
Coarse Red	38.27	14.65	21.82	21.	27.75	25.	13.30		23.5
Cascho	10.	10.	10.	10.	10.	10	10.		10.
Graycle									
Brown Cuppa	36	13.	13.	13.	35.	35	13.		30.
Natalena	21.	26.	18.13	17.87	22.	22.	25.45		21.
W.H.R.	5.	5	5.	5.			5.		5.
Parasol		12.	12.	12.			12.		
Coupons		15.	15.	15.			15.		
C									
D									
F									
G									
Ulexa		Fine Sulphur = 1.27%	Fine Sulphur = 1.27%	(No good)	Fine Sulphur = 1.63%	Same as X-2012-G	Med. Fine Sulphur = 0.24%	Med. Fine Sulphur = 2.46%	Fine Sulphur = 0.33%
Al Flake								1	
Lime									
Litharge									
Sulphur	4.73	4.35	5.05	6.13	5.25	5	4.25	4.	4.5
White Lead									
Zinc								43.	
Magnesia							2.	2	
Rubber	89.95%	78.24%	77.68%	76.60	94.42%		76.37%	90%	90.85%
Sul. to Rub	5.26%	5.56%	6.50%	8.00%	5.36%		5.56%	8%	5%
Accel. to Rub	0.30%	0.30%	0.35%	0.35%	0.35%		0.30%	2%	0.35%
Conf. of Vuls	3.84%	13.27%			3.84%		4.73%	3.08%	4.62
Total	100	100	100	100	100.	100	100	100	100
Sp. Grav. Cost and Prices	1.1				0.96		1.1	1.55	
Cure	55@47#	55@47#	55@47#	55@47#	55@47#	55@47#	55@47#	55@47#	55@47#
Stretch	Same as Cond. Set X-2012-F	Was Cured, Was Uneven	Cured Was Uneven	Over Cured Rotten	18¾	Same as X-2012-F	17	14½	19½
Strength		Was Uneven	Was Uneven	x 9	2575		1923	3372	1890
Set		All Right	Was Uneven		5/16		1/8	3/32	3/32
Color							Black		Black
Date	7-9-17	7-10-17	7-11-17	7-12-17	7-17-17	7-17-17	7-18-17	7-18-17	7-18-17
Remarks	X	X	X	X	X	X	X	X	X

NUMBER X 2014 MADE FOR P. O.

		A	B	C	D	E	F	G	H
S. Shorts		35	32	50.		50	50		
Coarse	23.27	23.99		17.	23.25				
Cascho	10.	10.			10.				
Graycle									
B. Cuppa	36.	36.	45		40.				
Natalena	21.	17.43	.18		17.				
W.H.R.		8.			5.				
Parasol	5.								
Pouches				15.					
Coupons									
Long Blank				25					
F									
G									
V-62				5	Fine Sulphur = 0.81%				
V-62									1
V-61						1			
Al Flake									
Lime									
Litharge									
Sulphur	4.73	4.58	5	2.75	4.75	4	4		
White Lead									
Zinc				14.5		43	43		
Magnesia						2	2		
Rubber	89.95%	87.15%	94.73%	67%	89.99%	50%	50%		
Sul. to Rub	5.26%	5.26%	5.27%	4.28%	5.28%	8%	8%		
Accel. to Rub	0.3%	0.30%	0.30%	0.247	0.28%	2%	2%		
Conf. of Vuls	4.67%			2.46	4.39%				
Total	100	100	100	84.10	100	100	100		
Sp. Grav. Cost and Prices	1.1	1.1			0.96	1.55			
Cure	53@47#	55@47#	53@47#	55@47#	55@47#	55@40#	40@40#		
Stretch	19¼	19¾	19¼	15½ in.	18 in.	15½			
Strength	2063	1990#	2290	2650	1905#	2189			
Set	1/8	3/32		5/16 in.	3 in.	3/32			
Color	Black			Grey	Black	Nat.			
Date	7-19-17	7-21-17	7-26-17	7-31-17	7-31-17	8-17-17	8-17-17		
Remarks	X	X	X	X	X	X	X		

Uniform

Same as X-2012-F

Vulcanizing

NUMBER X 2015 MADE FOR Stock Intaining 93 S. P. O

		A	B	C	D	E	F	G	H
S. Sheets	78.								
Cosyos									
Cascbo									
Guayule									
Natalina	18.								
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur	4.								
White Lead									
Zinc									
Total	100								
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date	9-17-17								
Remarks									

NUMBER X 2016 MADE FOR P O

			A	B	C	D	E	F	G	H
S. Sheets										
Cosyos										
Cascbo										
Guayule										
Pale Ceylon	73.	94.67								
Natalina	22									
V-5-5		.33								
A										
B										
C										
D										
F										
G										
Al Flake										
Lime										
Litharge										
Sulphur	5.	5.								
White Lead										
Zinc										
Total	100	100								
Sp. Grav. Cost and Prices										
Cure										
Stretch										
Strength										
Set										
Color										
Date	9-21-17	9-21-17								
Remarks										

NUMBER X 2017 MADE FOR Aerators P. O.

#		A	B	C	D	E	F	G	H
S. Sheets	50.	50.	50.	50	50.	50.			
Coarse									
Cumbe									
Graysite									
Thionera						1.			
Dyomich					1.				
A									
B									
C									
D									
F									
V-80				1					
V-83			1.						
V-118		1.							
V-57	1.								
Magnesia	2.	2.	2.	2.	2.	2.			
Al Flake									
Lime									
Lithage									
Sulphur	4.	4.	4.	4.	4.	4.			
White Lead									
Zinc	43.	43.	43.	43	43	43.			
Total	100	100	100	100	100.	100.			
Sp. Grav. Cost and Prices									
Cure	50'@40#	40'@40#	60'@40#						
Stretch	14½	14in.							
Strength	3150#	3070#							
Set	7/8	1/4							
Color									
Date	9-28-17	10-2-17	10-5-17	10-4-17	9-30-17	10-2-17			
Remarks	†	†	†						

NUMBER X 2018 MADE FOR Inner Tubes P. O.

Grey + Transparent

#		A	B	C	D	E	F	G	H
S. Sheets		75.25	62.	75.	69.75	69.75	93.5	69.75	99
Coarse									
Cumbe									
Graysite									
Cale Cryla	84.75								
Ulexa	1.								
Inertia	.25	.25			.25	.25		.25	
Natalene		15.	13.	38.					
Whiting				20.	20.	20.		20.	18.
C									
D									
F									
G									
Paraloid		5.			5	3.		4.	
Magnesia	1.00								
Al Flake									
Lime							.5		
Lithage									
Sulphur	5.	4.5	5.	5.	5.	5.	6.	5.	5.
White Lead									
Zinc	8.					2.		1.	
Rubber	84.76%						93.5		
Lead to Rub.	5.90%						55		
Cacal to Rub.	1.18%						✓		
Free Sul	2.44%						1.23%		
Comb. Sul	2.52%						3.49%		
Total	100.	100	100	100	100	100.	100.	100.	100
carg of Vulc.	3.20%								
Sp. Grav. Cost and Prices									
Cure	90@284#	90@284#	100@284	90@286	80@284	85@284	70@284	55@284	
Stretch	19in.	19	18½	18½	16	20	18	20in.	
Strength	2775#	1800	2125	2760#	2705	2775	2710	2700	
Set	3/32	1/16	1/4	1/8	3/32	1/4	1/8	3/32	
Color	Grey								
Date	10-3-17	10-4-17	10-5-17	10-9-17	10-9-17	10-9-17	10-27-17	10-27-17	
Remarks	3606-3.3.	99/284 - 19½ - 2470 - 3/16 - 3.26.							
	†	†	†	†	†	†			

NUMBER X 2019 MADE FOR Inner Tubes P.O. _____

	A	B	C	D	E	F	G	H
R. Havels	69.75	69.75	78.	85.	93.5	77	78	55
Cuero								
Caucho								
Guayule								
Utahica	20	20.	18.	10.		8	18	10
Thermoplastic Blend	25	25						
A								
B								
C								
D								
F								
G								
Peroxide		5.						
Tyrolith	4.							
Al Flake								
Lime				.5				
Litharge								
Sulphur	5.	5.	4.	5	6.	6	4	5
White Lead								
Zinc	1.							
Rubber						94.19%	95.19%	94.5%
Soft Whites						5.0	6.2	5.2
Acetone Soluble						.28	.28	.15
Free Sulphur						2.32%	1.14%	2.17%
Combined Sulphur						2.68%	2.89	2.53
Total	100	100	100	100	100	2/80	100	100
Sp. Grav. Cost and Prices								
Cure	Undercured	60@286	85@286	85@286	85@284	65@284	85@284	80@284
Stretch	120@279	19 in.	20½	20	20¼	20	21	20¼
Strength	Too long a cure to get	2640	2015	2415	2385	2015	2090	2420
Set		9/32	3/32	5/32	3/32	1/4	1/4	1/4
Color								
Date	10-5-17	10-4-17	10-12-17	10-12-17	10-21-17	7-27-18	7-27-18	7-27-18
Remarks	1	4	4	4	4	4	4	4

#3773-S.S.; 85@284 - 19 in - 2845 # - 9/32 in.

NUMBER X 2020 MADE FOR Red Inner Tubes P.O. _____

	A	B	C	D Too	E	F Fig.	G	H
R. Havels	69.5	75.75	68.	68.	82.	70	82.	82.	82.
Cuero							Sol = 3.6% Total = 4.39%	Sol = 4.53% Total = 4.81%	Sol = 4.72% Total = 4.97%
Caucho									
Guayule									
Utahica									
Utahica	13.		10.	10.		12.			
Amine		10.	5.	5.					
Golden Hub Regular Frazier & Co							18.	10.	
Germany Hub Co.								7.25	16.
F									
G									
Crimson F Hub				18.	18.				
Magnesia		1.							
Peroxide	5.								
Golden Hub	10.		15.	13.					
Al Flake									
Lime									
Litharge									
Sulphur	2.5	5.	2.	2.				.75	2.
White Lead									
Zinc		7.75		2.					
T.R. Red		.5							
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure	Undercured	80@284		155@286	155@286	150@286	155@286	150@286	
Stretch	120@279	16 in.		Both undercured		18½			18½
Strength	Too long a cure to get	2240		The Hub cement used		1590			2390
Set		3/32		contain enough		¼			¼
Color		Red		free sulphur.					
Date	10-5-17	10-5-17	10-9-17	10-10-17	10-11-17	10-11-17	10-11-17	10-11-17	10-12-17
Remarks	1	4	4	4	4	4	4	4	4

NUMBER X 2021 MADE FOR Red Inner Tubes P. O. _____

		A	B	C	D	36[illegible]	[illegible]	[illegible]	[illegible]
S. Sheets	77.25		63.5	62.5	69.5	69.5	69.5	69.5	82.
Coarse									
Caucho									
Guayule									
Ustho	12.		18.	18.	13.	13.	13.	13.	
Pale Crepe		86.25							
Wisp		.75							
A									
B									
C									
golden Fr. Fraguil regular			9.	9.			10.	16.	18.
crimson Fr. G.W.P. Co			8.	8.	10.	10.			
Magnesium		1.							
1401-Scarlet	1.	1.							
Prodorth	5.25				5	4.	5.		
Al Flake									
Lime									
Litharge									
Sulphur	4.5	4	1.5	1.5	2.5	2.5	2.5	1.5	
White Lead									
Zinc		5.		1.		1.			
Rubber								82.3	82
Sulfur to Rubber								601	7.4
Accel. to Rubber								.24	✓
Free Sulfur								353	276
Comb. Sulfur								142	219
Coef. of Vulc.								495	495
Total	100	100	100	100	100	100	100	100.	100.
								100 @ 236	158 @ 82
Sp. Grav. Cost and Price								19	21
								2570	2770
								1/4	1/4
								7-27-18	7-27-18
Cure	100@294	100@284		155@286	100@286	100@286	100@286	100@284	153@286
Stretch	19 1/2	16 1/2		18	19	19	19	19	18 1/4
Strength	1915	2676		2240	2400	2245	2250	2050	1850
Set	1/16	3/32		3/32	1/8	1/8	1/16	0/32	1/16
Color									
Date	10-11-17	10-12-17	10-12-17	10-19-17	10-18-17	10-19-17	12-4-17	12-4-17	12-7-17
Remarks	4	4	4	4	4	-1	4	-1	4

NUMBER X 2022 MADE FOR _____ P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets								82	
Coarse									
Caucho									
Guayule									
Renta #1 (Free S. 225 gl)								18	
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Trial	Ufje Tests on Gray Red Inner Tubes cont. acal.							100	
Sp. Grav. Cost and Price	X2018 F S.C.G.	X2019 E	X2019 F	X2019 G	X2021 H HAB	X2021 G			
Cure	85@284	55@284	85@284	80@284	153@286	100@286			
Stretch	18½-16½-7	19½-18½-15½	22-17-16	19½-18½-6	20-18-15	18½-17½-14½			
Strength	3400-1750-1550	2390-2100-1350	2235-1750-1675	2590-2190-1575	2290-1750-950	2390-2320-1575			
Set	¼-¼-0	5/16-¼-¼	½-5/16-¼	5/16-½-0	¼-5/16-¼	3/16-5/16-¼			
Color									
Date									
Remarks	One week →	3 weeks →	6 weeks →	One week →	3 weeks →	6 weeks →	One week →	3 weeks →	6 weeks →	One week →	3 weeks →	6 weeks →	One week →	3 weeks →	6 weeks →	aged in oven at 53°C. 25

Comparison Carbon Black Washed + Unwashed
+ Inertia)

NUMBER X 2023 MADE FOR Smoked Sheets P.O.

		A	B x-105 S.G.	C	D	E	F	G	H	I
~~Smoked Sheets~~					50	50	50	50	50	50
Coarse			X							
Caucho										
Guayule										
W. L. L.	93.5		50							
UnW. L. L.		93.5		50.						
Δ Brand Carbon Black (Boston Chemical Co. Carbon Co.)										18
A										
B										
C										
D										
F										
G										
W. R. X.			10.	10.	10	10	10	10	10	10
Inertia			18.	18.	~~18~~				18	
Excello Carbon Black Boston Chemical Carbon Black & Carbon Co. Boston						18				
Al Flake							18			
Lime	.5	.5	1.	1.	1	1	1	1	1	1
Litharge			3.	3.	3	3	3	3	3	3
Sulphur	6.	6.	3.	3.	3	3	3	3	3	3
White Lead										
Zinc			15.	15.	15	15	15	15	15	15
Carbon Black L.N. Butler Co			Why the lime, litharge, and sulphur last.					18		
Total	100.	100	100	100	100	100	100	100	100	
Sp. Grav. Cost and Prices										
Cure	85@284°	85@284°	65@53°	65@53°	65/53°	65/53°	65/53°	65/53°	65/53°	65/53°
Stretch	20 in.	19½ in.	16 in.	16¼ in.	15½	15	14¼	14¼	16	16
Strength	1830#	1315#	2570#	2600#	2195	2100	2000	2110	2110	2000
Set	9/32 in.	7/32 in.	1 1/16 in.	1 1/8 in.	1	1	1	1	3/4	15/16
Color		grey	Black	Black	Black	Black				
Date		1-5-17	1-5-18	1-5-18	9-7-18	9-7-18	2/8/19	2/13/19	2/26/19	2/26/19

Remarks

Washed and Unwashed

NUMBER X 2024 MADE FOR Brown Crepe, P.O.

		A	B	C	D	E	F	G	H
~~Smoked Sheets~~									
Coarse									
Caucho									
Guayule									
~~Smoked Sheets~~									
~~Smoked Sheets~~									
Washed B.C.	93.5		50.		78.				
Unwashed B.C.		93.5		50.		78.			
B									
C									
D									
F									
G									
W. R. X.			10.	10.	7.	7.			
Inertia			18.	18.					
Al Flake									
Lime	.5	.5	1.	1.					
Litharge			3.	3.	3.	3.			
Sulphur	6.	6.	3.	3.	5.	5.			
White Lead									
Zinc			15.	15.	8.	8.			
			Why the lime, litharge and sulphur last.						
Total	100	100.	100.	100.	100.	100			
Sp. Grav. Cost and Prices			75 & 5 B		75 & 47				
Cure	Did not cure	Did not cure							
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2025 MADE FOR Hard Rubber Stock P O.

		A	B	C	D	E	F	G	H
S. Sheets	22								
Coarse									
Caucho									
Guayule									
Natalene	50								
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulpher	28.								
White Lead									
Zinc									
Rubber	71.25								
Accel. to Rub	1.05								
Sul to Rub	39.25								
Free Sul									
Coef. of Vuls									
Total	100								
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

Age test of Stock

NUMBER X 2026 MADE FOR Cont Liquid Rubber P O

		A	B	C	D	E	F	G	H
S. Sheets	50	50							
Coarse									
Caucho									
Guayule									
M R X	10	12							
Diverta	15	15							
A									
B									
C									
D									
F									
G									
Al Flake									
Lime	1	1							
Litharge	3	3							
Sulpher	3	3							
White Lead									
Zinc	15	15							
Palm Oil	2								
Liquid Rubber		2							
Total									
Sp. Grav. Cost and Prices			X2026 and X2026A one week aging	X2026 and X2026A two weeks aging	X2026 and X2026A three weeks aging	X2026 and X2026A 5 weeks aging	X2026 and X2026A 7 week aging	X2026 and X2026A 9 weeks aging	
Cure		65/53	65/53	65/53	65/53	65/53	65/53	65/53	65/53	65/53	
Stretch		14½	15¼	14	15	12½	14	11½	12½	8½	10½	6½	9½	8	8	
Strength		2745	3000	2300	3360	2265	2760	2150	2700	1905	1600	990	1305	1175	1225	
Set		½	½	5/8	9/16	9/16	5/8	9/16	7/16	5/8	5/8	3/16	5/8	7/16	½	
Color		Black	Black													
Date		6-11-18	6-11-18	7-1-18	7-8-18	7-15-18	7-29-18	8-12-18	8-26-18							
Remarks				aged in oven at 55°C												

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Acid Resistant

NUMBER X 2027 MADE FOR Stock. P. O. .....

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Caarbo									
Guayule									
Mocha	20	23							
Wetho	5	7							
Amine	5								
A									
B									
C									
D									
F									
G									
Paraffin	5	2.5							
M.P.X	5	5.							
[illegible]									
Lime									
Litharge									
Sulphur	1.5	2.							
White Lead									
Zinc									
Al Flake	40.	40.							
Baryta	18.5	20.5							
Total	100	100							
Sp. Grav. Cost and Prices	Blend up with a mixture of Gutta Percha, Rubber, Resin & Whiting								
Cure									
Stretch									
Strength									
Set									
Color									
Date	3-27-18	3-28-18							
Remarks									

NUMBER X 2028 MADE FOR Compressed Asbestos Sheet & Packing Co. Elizabeth, N.J. & Chicago, Ill.

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	50	50	50	50
Coarse									
Caarbo									
Guayule									
Granite	2	2	2					2	
Fibre & Asbestos Rayon				2 (Butcher)					2 (White)
A									
B									
C									
D									
F									
G									
Prepared Hexamethylene Tetramine (Smart Weiring) " Recrystallized					1	1	1		
Al Flake									
Lime									
Litharge									
Sulphur	3	3	3	3	4	4	4	3	3
White Lead									
Zinc	47	47	47	47	43	43	43	47	47
Magnesia					2	2	2		
Total	102	102	102	102	105	100		102	102
Sp. Grav. Cost and Prices									
Cure	50/40	50/40	50/40	50/40	50/40	50/40	50/40	50/40	50/40
Stretch	13	13	13	13	13	13	13 1/2	10 1/2	10
Strength	1755	1970	2057	2055	1905	1770	2660	3283	3250
Set	5/16	5/16	5/8	5/16	7/16	3/16	5/16	9/16	5/16
Color									
Date	4-13-18	4-13-18	5-7-18	5-7-18	10-6-18		10-16-18		
Remarks									

NUMBER X 2029 MADE FOR Test Recipes for Glue P. O. _____

		A	B	C	D	E	F	G	H
B. Sheets	15	22	42	50	50	30	37		
Coarse									
Casein									
Guayule									
Linseed Oil	35	35							
Wood Rosin			8	8					
Gum [illegible]						20	20		
A									
B									
C									
D									
F									
G									
Ginger								36	43
M Glue								14	14
Al Flake									
Lime									
Litharge	[illegible]	[illegible]	[illegible]	10	10	10	10	10	10
Sulphur	3	3	3	3	3	3	3	3	3
White Lead									
Zinc	37	30	37	29	37	37	30	37	30
Total	[illegible]	[illegible]	[illegible]	[illegible]	100	100	100	100	101
Sp. Grav. Cost and Prices									
Cure	30/50#	30/50#	30/50#	30/50#	30/50#	30/50#	30/50#	30/40	30/40
Stretch	13½	13	9½	11	13½	11½	12½	13½	14½
Strength	2355	2435	1350	1515	2800	2380	2640	1950	2735
Set	½	½	¼	¼	½	9/16	9/16	½	½
Color									
Date	4-27-18	4-27-18	4-27-18	4-27-18	4-27-18	4-30-18	4-30-18	5-2-18	5-2-18
Remarks									

NUMBER X 2030 MADE FOR Action of Organic Compounds in a Pure Gum Stock. P O _____

	Standard Recipe	A	B	C	D	E	F	G	H
B. Sheets	90. (#3793)								
Coarse									
Casein									
Guayule									
A									
B									
C									
D									
F									
G									
Al Flake									
Lime	1.								
Litharge									
Sulphur	9.								
White Lead									
Zinc									
Free Sulphur Carb. of Rosin									
Total	100								
Sp. Grav. Cost and Prices									
Cure	85/285#								
Stretch	19½								
Strength	2708								
Set	9/16								
Color									
Date									
Remarks									

NUMBER X 2031 MADE FOR Cocalabetortests P O. _____

	A	B	C	D	E	F	G	H	I
S. Sheets	50	50	50	50	50	50	50	50	50
Starch									
Casein									
Oxzyole									
Finger Spool A		1							
" " B			1						
" " C				1					
" " D					1				
" " E						1			
" " F									
Fornicl #999							20	37.3	1
Al Flake									
Lime									
Lithorge									
Sulphur	4	4	4	4	4	4	4	4	4
White Lead									
Zinc	44	43	43	43	43	43	43.7	43.5	43
Zinc Ox	2	2	2	2	2	2	2	2	2
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cast and Press									
Cure	58/40	58/40	58/40	58/40	58/40	58/40	58/40	20 40	60/40
Stress	12	13 1/2	15	15	15	14 1/2	15	15	15
Strength	1255	1255	1965	2020	1940	2655	2725	2860	2995	2895
Set	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16
Color	Light Straw	Light Straw	Light Straw	Light Straw	Light Straw	Light Straw	Light Straw		
Odor									
Remarks									

NUMBER X 2032 MADE FOR Comparison Stearine Oil Zinc Oxide P O. Gulf Refining Co

	A	B	C	D	E	F	G	H
S. Sheets	50	50	50	45	43	50	50	50
Starch								
Casein								
Oxzyole								
Delete				32				
Dr Soot (Vanderbilt)					32			
A								
B								
C								
D								
E								
F								
G								
Zinc Ox (Vanderbilt CNJ)						37		
Fornicl								37
Al Flake		37	37				37	
Lime								
Lithorge	10	10	10	10	10	10	10	10
Sulphur	3	3	3	3	3	3	3	3
White Lead								
Zinc	47			10	10			
Chromine		31						
Total	100	100	100	100	100	100	100	100
Sp. Grav. Cast and Press								
Cure	30/40	45/40	30/40	30/40	30/40	30/40	30/40	30/40
Stress	14 3/4	12 1/4	12 1/4	12 1/4	14	14	11	16
Strength	3305	1000	1815	1835	2835	2520	2080	2100
Set	5/16	1/4	1/4	1/4	3/4	7/16	3/16	1/4
Color	Straw	Dark Straw			Straw	Straw		
Odor								
Remarks								

NUMBER X 2033 MADE FOR Pipemouth Stock P O Pipeline

		A	B	C	D	E	F	G	H
S. Sheets	50	23	30						
Coarse									
Cassia									
Guarnie									
Glutton D		27	27						
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge	10	10	10						
Sulphur	3	3	3						
White Lead		3							
Zinc	37	37	30						
Total	100	100	100						
Sp. Grav. Cost and Prices									
Cure	30/50	30/50	30/50						
Stretch	15/16	12/16	14						
Strength	3675	2735	2740						
Set	1/2	5/8	1/2						
Color	Dark Grey	Darkkey	Dark Grey						
Date	July 26-1	July 26-1	July 26-1						
Remarks									

NUMBER X 2034 MADE FOR Accelerator test P O

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	50	50	50	50
Coarse									
Cassia									
Guarnie									
Chemfillmore		+							
Diphenylguanidine		+							
Methylstearamide			1.5	1	2				
A									
B									
C									
D									
F									
G						2			
Diphenylguanidine						1			
Phenyl-beta-naphthylamine						1	.5	5	
Resistoflex Flower (Flow Aid)									1
Engine Black									
Al Flake									
Lime									
Litharge									
Sulphur	4	4	4	4	4	4	4	4	4
White Lead									
Zinc	43	43	42.5	43	43	43	43.5	43.5	43
Engine	2	2	2	2	2	2	2	2	2
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure	40/45		40/40	25/65		20/30			
Stretch	14/16		14/16	15		14/16			
Strength	2720		3056	3055		3000			
Set	1/2		11/16	1/2		1/2			
Color									
Date	10-22-A		10-22-A	10-22-A		10-22-A			
Remarks									

20/30

14 1/2

3000

1/2

2-10-19

Plaintiff's Exhibit No. 10

32

NUMBER X 2035 MADE FOR Test on Combo Crepe #4235 P. O.

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Uvacho									
Guayule									
[illegible]	50								
[illegible]									
[illegible]		30							
A									
B									
C									
D									
F									
G									
[illegible]			30						
Al Flake									
Lime		1	1						
Litharge		5	5						
Sulphur	3	4	4						
White Lead									
Zinc	47	10	10						
Total	150	100	100						
Sp. Grav. Cost and Prices									
Cure	60/40	50/40	50/40						
Stretch	15 1/2	14 1/4	8 1/2						
Strength	2425	1375	1430						
Set	0/16	3/8	3/8						
Color									
Date	2-10-15	2-11-15	2-10-15						
Remarks									

Comparison of Carrara Filler from Amer. Spreader & Co. Cleveland Ohio roller filler

NUMBER X 2236 MADE FOR Against Al Flake P. O.
Fossil Flour against Tripoli

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	50	50	50	50
Coarse									
Cacho									
Guayule									
Mexican White (Rubberized Sheet)						40			
Smith							40		
Light Blue Rubberized Sheet								30	
A									
B									
C									
D									
F									
G									
Fossil Flour Tripoli				30	30				
Carrara Filler		20							
Al Flake	30		30 (O.T. Volume)						
Lime	1	1	1	1	1	1	1	1	1
Litharge	5	5	5	5	5	5	5	5	5
Sulphur	4	4	4	4	4	4	4	4	4
White Lead									
Zinc	10	10	10	10	10			10	10
Whiting									30
Total	100	100	100	100	100	100	100		
Sp. Grav. Cost and Prices									
Cure	60/40	45/40	50/40	50/40	50/40	50/40	50/40		
Stretch	12	14 1/4	13 1/2	8 1/2	12 1/4	14 1/2	15 1/2		
Strength	1370	1920	1290	1435	1470	1935	2465		
Set	1/2	1/2	3/8	3/8	7/16	5/8	1/2		
Color	Gray	Gray	Gray						
Date	12-9-15	12-10-15	12-26-15	4-23-16	4-25-16	5-2-16	5-2-16		
Remarks									

NUMBER X 2037 MADE FOR Mnfr. Supply Co. P. O. Also Selects = Blend Middle Run Grade

		A	B	C	D	E	F	G	H
R. Rheeta	50	50	45	45					
Coarse									
Caucho									
Guayule									
Scrap			32						
Blend Middle Run Grade				32					
A									
B									
C									
D									
F									
G									
Al Flake	10	10							
Lime									
Litharge	10		10	10					
Sulphur	5	5	3	3					
White Lead									
Zinc	25	25	10	10					
MnO_2		10							
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure	40/40	10/65	39/40	39/40					
Stretch	14 1/2	14 5/8	14 3/4	14 3/4					
Strength	2775	2200	2520	2525					
Set	3/16	3/4	1/2	1/2					
Color	Black	Gray							
Date	12-26-19	1-2-19	2-10-20	2-10-20					
Remarks									

NUMBER X 2035 MADE FOR Goodrich Akron P. O. Autoture Finish Shoddy

		A	B	C	D	E	F	G	H
R. Rheeta									
Coarse									
Caucho									
Guayule		90							
A									
B									
C									
D									
F									
G									
Shoddy	90								
Al Flake									
Lime	1	1							
Litharge									
Sulphur	9	9							
White Lead									
Zinc									
Total	100	100							
Sp. Grav. Cost and Prices									
Cure	30/40	34/40	32/40						
Stretch	11 3/4	8/4	11 1/2						
Strength	1235	460	525						
Set	7/8	3/8	1/4						
Color	Gray								
Date	1-25-19	2-20-19							
Remarks	returned	undressed							

NUMBER X 2039 MADE FOR. Tecolostro P O.

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	50	50	50	50
Course									
Cassabo									
Guayule									
XTGum 25 pct	1								
XTGum 25 pct		1							
A									
B									
C									
D									
XT. Gum dipping from 1st hopl (2nd crop)					1				
XT. Gum dipping from 1st hopl (2nd crop)						1			
XT. Gum from 1st hopl (crop)			1						
XTGum direct from tree (crop)				1					
Carbonate							1		
Al Flake									
Lime									
Litharge									
Sulphur	4	4	4	4	4	4	4	4	4
White Lead									
Zinc	43	43	43	43	43	43	43	43	43
Magnesia	2	2	2	2	2	2	2	2	2
Phosphorus								1	
Phosphorus Sulphur									1
Total	100	100	100	100	100		100		100
Sp. Grav. Cast and Prime									
Cure	50/40	50/40	60/40	55/40	50/40	50/40	55/40		40/40
Stretch	14½	14½	14½	14½	14½	14½	15		15¼
Strength	2840	3165	2950	3230	3105	3065	2785		2955
Set	4/5	5/8	3/4	3/4	3/4	3/4	5/8		3/4
Color									
Date	1-28-19	1-28-19	2-4-19	2-7-19			1-28-19		2-4-19

Remarks

NUMBER X 2040 MADE FOR Tolaima Sap P O Titanio B

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	96½	50	50	
Course									
Cassabo									
Guayule									
Ca. Sap.		44	25	12.5		14			
Gum						3½			
A									
B									
C									
D									
F									
G									
Titanio B-X								45	
Basic White Lead						14			
Al Flake									
Lime							1	1	
Litharge			4	6	6	4			
Sulphur	4	4	4	4	4	8	4	4	
White Lead									
Zinc	44		15	26.5	39	24	45		
Magnesia	2	2		1	1	2			
Total	100	100	100	100	100		100	100	
Sp. Grav. Cast and Prime				1.35	1.55				
Cure				60/45	60/40		55/40	65/40	
Stretch				14½	16¼		14	15	
Strength				2752	2600		2050	2115	
Set		Blank	Blank	1/2	3/4		5/8	3/4	
Color									
Date				1-7-19	2-7-19		Aug 15-19	Aug 19-19	

Remarks

NUMBER X 2041 MADE FOR Compressor Appliance with rubber tube P.O.

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50					
Cuorse									
Cuocho									
Onyrals									
A									
B									
C									
D									
F									
G									
Phthroscinal (3)			1	.5					
Phthroscin oil		.5	.5						
Chlorinated Sulphur	.5	.5							
Al Flake	2		2	2					
Lime									
Litharge									
Sulphur	4	4	4	4					
White Lead									
Zinc	435	435	43.5	43.5					
Magnesia		2							
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure	39/40	25/40	35/40	40/40					
Stretch	15	14	14½	14					
Strength	3110	2970	3100	3050					
Set	5/8	9/16	7/8	6/16					
Color									
Date	2-15-19	2-15-19	3-6-19	4m25-19					
Remarks									

NUMBER X 2042 MADE FOR Accelerators P.O.

		A	B	C	D	E	F	G	H
S. Sheets			50	50					
Cuorse									
Cuocho									
Onyrals									
Diphenylguanidine		1							
Triphenylguanidine				1					
Diphenyl Thiourea			1						
A									
B									
C									
D									
F									
G Stolly	68	68							
Hydrolene	10	10							
Lampo	3	3							
Fuel Flour	12	12							
Quercitron	1½	1½							
Al Flake									
Lime	2¼	2¼							
Litharge	1								
Sulphur	2½	2¼	4	4					
White Lead									
Zinc			43	43					
Mag			2	2				1	
Total	100	100	100	100					
Sp. Grav. Cost and Prices	1.64	1.60							
Cure	38/274	20/274	50/40	39/40					
Stretch	3½	3½	16	14½					
Strength	630	620	3035	2890					
Set	4/8	4/8	9/10	5/8					
Color									
Date	2-24-19	3-4-19	1-4-19	1-4-19					
Remarks									

NUMBER X 2043 MADE FOR Comparison M.R. Quartz + Carbon Black P.O. ____

		A	B	C	D	E	F	G	H	
N. Stocks	50	50	50	50	50	50	50	50	50	50
Cosmo										
Coumbo										
Sicksyde								1		
Hydrobine	10									
Aquarius	15	18	18	18	18	18	18	18		18
B.N.R			10						10	10
A										
B										
C										
D										
F										
G										
#15 Peroketa		10								
#8 Peroketa				10						
#23 Peroketa					10					
#20a Peroketa						10				
Al Flake										
Lime	1	1	1	1	1	1	1	1	1	1
Litharge	3	3	3	3	3	3	3	3	3	3
Sulphur	3	3	3	3	3	3	3	3	3	3
White Lead										
Zinc	15	15	15	15	15	15	15	15	15	15
Vulkanox 4010 NA/LG							10			
Vulkanox 4010 NA/LG								10		
Perkacit TBzTD/C									10	
Total	150	100	126	100	100			100	100	100
Sp. Grav. Cast and Press										
Cure	60/53	60/53	60/53	60/53	60/53	60/53		60/53	60/53	60/53
Growth	16	16 1/2	16 1/4	17	17	16 1/2		15	15	15
Strength	2090	2490	2630	2210	2590	2360		2640	2180	2140
Set	1	1	9/8	9/8	13/16	1		1	9/8	1
Color										
Date	3-10-19	3-10-19	3-10-19	3-10-19	3-10-19	3/24/19		5-2-19	5-2-19	5-2-19
Remarks										

NUMBER X 2044 MADE FOR Comparison Pale with white made by other companies P.O. ____

		A	B	C	D	E	F	G	H
B. Blanc									
Cosmo									
Coumbo									
Sicksyde									
Blanc fixe	154/lbs	154/lbs	154/lbs	154/lbs	209				
Cosmic Coupling	4 1/2								
" Nat Rubber &		4 1/2							
" Polybutadiene Engineering			4 1/2						
" Synthetic				4 1/2					
C									
D									
F									
G									
Stearic + 1/2 wax blend					9				
Al Flake									
Lime									
Litharge									
Sulphur	9	9	9	9	18				
White Lead									
Zinc	150	150	150	150	240				
Total	[illegible]								
Sp. Grav. Cast and Press									
Cure	60/40	60/40	60/40	44/40	60/40				
Growth	13 1/2	14 1/2	14 1/2	16	15 1/2				
Strength	860	1950	2235	2/35	2360				
Set	1/4	1/2	6/8	1/2	1/2				
Color									
Date	3-20-19	3-20-19	3-20-19	3-20-19	3-20-19				
Remarks	Blended	Blended	Blended	Blended	Blended				

NUMBER X 2045 MADE FOR Dope & Accelerator P. O.

		A	B	C	D	E	F	G	H
S. Sheets									
Coorse									
Czechs									
Gunyule									
Zinsyn	66.15	63	63	89.5	55			90	
Beaufort Resin		3.15							
Dope 20 Inhibited			3.15						
A									
B									
C									
D									
F									
G									
P Colindine				5	.5	.5	.5		
Batanga						8.5	5.5		9.0
Al Flake									
Lime									
Litharge	7.87	7.87	7.87	4	3	4	2	4	4
Sulphur	2.37	2.37	2.37	6	3 1/2	6	3 1/2	6	6
White Lead									
Zinc					39		39		
Inerting	23.6	23.6	23.6						
Total	99.99	99.99	99.99	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure		35/45	40/45	45/45	60/45	45/45	60/45	55/45	140/45
Stretch		14	13 1/4	19 1/2	15	16	14 1/4	18 1/2	12 1/2
Strength		3570	3135	1995	2420	870	1525	1565	405
Set		7/8	3/4	1/4	1 1/2	3/8	7/16	5/16	3/32
Color		Black							
Date		4-25-19	9-11-19	9-29-19	9-29-19	9-23-19	9-22-19	9-29-19	9-29-19
Remarks									

NUMBER X 2046 MADE FOR M R Compression also Talk Dust & Accel P. O.

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50	50	50	50	
Coorse									
Czechs									
Gunyule									
Rosin MR #1	10								
Rosin MR #1 Hydrogenated		10							
Inerting	18	18						18	18
A									
B									
C									
D									
F									
G									
Rosin MR #2			10						
Rosin MR #1 Hydrogenated				10					
A.A. Retarder					10				
Talk Dust						18			
Al Flake									
Lime	1	1	1	1	1	1	1	1	
Litharge	3	3	3	3	3	3	3	3	
Sulphur	3	3	3	3	3	3	3	3	
White Lead									
Zinc	15	15	15	15	15	15	15	15	
B.M.R.						10			
MR #1 HH Retarder							10		
MR #2 " "								10	
Total	100	100	100	100	100	100	100	100	
Sp. Grav. Cost and Prices									
Cure	65/53	65/53	65/53	65/53	65/53	65/53	65/53	66/53	
Stretch	15	14 1/2	15	14 1/2	14 1/2	14 1/4	15	15 1/2	
Strength	1635	2195	2255	2100	1930	1485	2215	2170	
Set	3/4	3/8	3/4	3/8	3/4	3/8	1	1	
Color									
Date	4-28-19	4-28-19	4-28-19	4-28-19	4-28-19	6-17-19	7-26-19	7-26-19	
Remarks									

NUMBER X 2047 MADE FOR Comparison B Thistle brand of magnesia P. O.

		A	B	C	D	E	F	G	H	X
S. Shorts	50	50	50	50	50	50	50	50	50	50
Cocoa										
Cassia										
Gunyule										
A										
B										
C										
D										
F										
G										
Magnesia (Thistle brand)	2	2		3	3	3	3	3		
Al Flake	2	4	19-19							
Lime										
Litharge										
Sulphur	4	4	4	4	4	4	4	4	4	4
White Lead										
Zinc	44	44	44	43	43	43	43	43	43	43
Magnesia (Thistle brand)									3	
Al (Thistle Brand)										3
Total	100	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Price										
Cure				70/45	75/40	70/45	70/45	80/45	70/45	70/45
Stretch				14 3/4	14 3/4	15	15	15	14 1/2	14 1/2
Strength				2430	2120	3215	2845	2450	3370	2830
Set				5/8	1/2	1/2	5/8	5/8	9/16	7/8
Color										
Date				6-13-19	6-17-19	6-17-19	8-19-19	10-1-19	12-5-19	12-5-19
Remarks										

NUMBER X 2048 MADE FOR Color Compounds P. O.

		A	B	C	D	E	F	G	H
S. Shorts									
Cocoa									
Cassia									
Gunyule									
Ceylon	50	50	50						
A									
B									
C									
D									
F									
G									
Bengal Red	30								
Carbonate Red		30							
Carmine 9 HA			2						
Al Flake									
Lime	3 1/4	3 1/4	3 1/4						
Litharge									
Sulphur	1 3/4	1 3/4	1 3/4						
White Lead									
Zinc									
Comalt	15	15	15						
Whiting			28						
Total	100	100	100						
Sp. Grav. Cost and Price		4							
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X 2049 MADE FOR Red Cameron Tubes P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	85	87 5		92	82				
Coarse									
Caseho									
Guayule									
Kenta #1	18	18							
Indian		.5							
Kenta #2				18					
Kenta #3					18				
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total	100	100		100	100				
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2050 MADE FOR MR Compounding P O

		A	B	C	D	E	F	G	H
S. sheets	50	50	50	50					
Coarse									
Caseho									
Guayule									
M.R X	10								
Quantum	18	18	18	18					
Kenta M.R	Burlam 10	10							
A									
B									
C									
D									
F									
G									
Hardwood Pitch			10	10					
" " "									
Al Flake									
Lime	1	1	1	1					
Litharge	3	3	3	3					
Sulphur	3	3	3	3					
White Lead									
Zinc	15	15	15	15					
Total	100	100	100	100					
Sp. Grav. Cost and Prices									
Cure	65/53	65/53	65/53						
Stretch	17 3/4	17 3/4	15						
Strength	2050	2305	1275						
Set	1 1/2		1						
Color									
Date	8-28-09	8-28-09	9-5-09						

Remarks

NUMBER X 2051 MADE FOR Accelerators for sulphate

		A	B	C	D	E	F	G	H
S. Rhoto									
Coarse									
Caustic									
Quayule									
A									
B									
Sheddy C	93	95	95.5	93.	[illegible]	5			
D									
F									
G									
Rubber						5			
V-5-5		.5		5	.3				
Al Flake									
Lime	1								
Litharge	2								
Sulphur	4	4.5	4.5	4.	[illegible]	4½			
White Lead									
Zinc				2.5					
Total	102	105	100	100		100			
Sp. Grav. Cost and Prices	Standard Rubber Compound								
Cure	40@30#	40@30#	50@40#	20@60#					
Stretch	9in	8¾in	7in	5¾in					
Strength	690#	755	655#	675#					
Set	⅞in	¾	⅝	½					
Color	Black	Black	Black	Black					
Date	8-9-17	8-20-17	8-31-17	8-22-17					
Remarks									

NUMBER X 2052 MADE FOR Hard Rubber Lead alpront valves

		A	B	C	D	E	F	G	H
S. Rhoto									
Coarse									
Caustic									
Quayule									
Zinger	15	10	20						
Kalgan	10	20							
A									
B									
C									
D									
F									
G									
Rubber									
Union	30	30	30						
Al Flake	8	8	8						
Lime	2	2	2						
Litharge									
Sulphur	0	0	10						
White Lead									
Zinc	0½	7	19						
Red Oxide	5½	3	8						
Prussian Blue	3	3	3						
Total	[illegible]	[illegible]	[illegible]						
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X 2053 MADE FOR Ilne-Rubber Company P O

		A	B	C	D	E	F	G	H	
S. Sheets	36	43					~~36~~	~~43~~	36	43
Cumo										
Cumbo										
Guayule										
Kang. SS + 3 lbs Bl. Ox. + 3 lbs Calenja Ilne	14	14	14	14	14	14				
A										
B										
C										
D										
F										
G										
Bl. Crepe #130 #131			36	43	36	43	36 14	43 14	36 14	43 14
Al Flake										
Lime										
Litharge	10	10	10	10	10	10	10	10	10	10
Sulphur	3	3	3	3	3	3	3	3	3	3
White Lead										
Zinc	37	30	37	30	37	30	37	30	37	30
Total	100	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices										
Cure	30/40	30/40	30/40	30/40	30/40	30/40	30/40	30/40	30/40	30/40
Stretch	14	15	12½	14¼	10	12	13¼	13	13¾	11½
Strength	3000	3240	1495	1420	1055	1095	1080	1375	1440	1400
Set	5/8	3/4	3/8	3/8	4/4	3/8	1/8	4/4	3/8	3/8
Color										
Date	19/3/19	19/3/19	19/3/19	19/3/19	19/3/19	19/3/19	23/3/19	23/3/19	23/3/19	23/3/19
Remarks										

NUMBER X 2054 MADE FOR ~~Ilne Rubber Company~~ Ilne Rubber Comparison P O

		A	B	C	D	E	F	G	H
S. Sheets	50	23	30	36	43	36	43	36	
Cumo									
Cumbo									
Guayule									
Shutan D		27	27						
Ilne S			--	14	14				
Ilne R						14	14		
A									
B									
C									
D									
F									
G									
R-Ilne M 500 Innerdal Bl. Ox.								14 36	14 43
Al Flake									
Lime									
Litharge	10	10	10	10	10	10	10	10	10
Sulphur	3	3	3	3	3	3	3	3	3
White Lead									
Zinc	37	37	30	37	30	37	30	37	30
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure				30/40	30/40	30/40	30/40	60/80	60/80
Stretch				14	15	14	14½	11½	12½
Strength				2918	3075	2640	2790	1350	1400
Set				1/2	1/2	7/8	1/2	1/4	5/16
Color									
Date				3-12-19	3-12-19	3-12-19	3-12-19	4-8-19	4-8-19
Remarks									

NUMBER X 2055 MADE FOR Govt Specification 90% Hevea Rubber. P. O.

		A	B	C	D	E	F	G	H
S. Rhodia	90.	78.25	78.25	80.25	80.	80.	84.		
Cumar									
Cumar									
Oxzyde									
Vatalene		12.	12.	10.	10.	10.	6.		
A									
B									
C									
D									
F									
G									
Magnesia							1.		
Powdered			5.25						
Al Flake									
Lime	1.								
Lithopone	4.5								
Sulphur	4.5	4.5	4.5	4.5	4.	3.5	4.		
White Lead									
Zinc		5.25		5.25	6.	6.5	5.		
Rubber	90%	90.07%	90.07%	90.10	89.85%	89.85%			
Acid to Rub.	5%	4.99%	4.99%	4.99%	4.95%	5.90%			
Acid-720	4.33%	80%	220%						
Accel to Rub.		0.167%	0.167%	0.167%	0.167%	0.167%			
Surf of Tube									
Total	100.0	100.00	100.00	100.00	100.	100.0	100.		
Sp. Grav. Cmd and Prime	1.30								
Cure	45#47"	40#47"	65#47"	40#47"					
Stretch	20½"	16½"	30"	14½"					
Strength	2477#	2650#	2693#	2995#					
Set	5/16	9/32	Nil.	Nil					
Color	Black	Brown	Brown	Brown					
Date	8-29-17	8-29-17	8-29-17	8-29-17	9-4-17	9-4-17	10-16-17		
Remarks	1	4	4	4	4	4			

NUMBER X 2056 MADE FOR Gasoline Impervious stock Adhesion test

		A	B	C	D	E	F	G	H - I
S. Rhodia	30	37	30	37	30	37	6	13	17.5
Cumar									
Cumar									
Oxzyde									
Vatalene #1	20	20							
Vat. #2			20	20					
Vat. #3					20	20			
A									
B									
C									
Blue-D							44	44	50 31.25
F									
G									
Al Flake									
Lime									
Lithopone	10	10	10	10	10	10	10	10	10 10
Sulphur	3	3	3	3	3	3	3	3	3 3
White Lead	37	30	37	30	37	30			
Zinc	37	30	37	30	37	30	37	30	31 37
Total	100	100	100	100	100	100	100	100	
Remarks	Good surface Adhesion to Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs	Adhesion to duck as above Duck = 31.25 lbs Rubber to Rubber = 50 lbs
Cure	30/50	30/50	30/50	30/50	30/50	30/50	30/50	30/50	
Stretch	12"	13"	11¼	13	12	13½	10½	14½	
Strength	2575	2905	2440	2935	2330	2985	2965	3270	
Set	3/16	9/32	1/2	9/32	3/16	9/32	5/8	9/32	
Color	Black	Black	Black	Black	Black	Black	Black	Black	
Date	4-30-18	4-30-18	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	6-13-18	
Remarks									

NUMBER X 2057 MADE FOR Govt Specification 45% Hevea Rubber P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	45.	37.	37.	37.	40.	40.	40.		
Coarse									
Caucho									
Guayule									
Hatsleva		8.	8.	8.	5.	5.	5.		
A									
B									
C									
D									
Whiting						6.5	11.5		
Tonolite						30.			
Magnesia					1.	1.	1.		
Black Lead				1.					
Ulexa			.25	.25	.25	.25	.25		
Barytes	10.	10.	10.	10.	10.		10.		
Al Flake	10.	12.75	12.50	11.50	11.50				
Lime	1.								
Litharge	7.								
Sulphur	3.5	2.25	2.25	2.25	2.25	2.25	2.25		
White Lead									
Zinc	23.5	30.	30.	30.	30.	15.	30.		
Rubber	45%	45%	45%	45%					
Sol'd Rub.	7.77%	5%	5%	5%					
Sol'd Rub-Phs	5.55%								
Accel'd Rub.		0.266	0.266	.266%					
Sol'd Vulc-									
Total	100.0	100.00	100.00	100.00	100	100.	100.		
Sp. Grav. Cost and Prices								X 2057 D aged 9 months	X 2057 E aged 9 months
Cure	45@45#	45@45#	45@45#	40@45#	15@60#	15@60#	15@60#	15@60	15@60
Stretch	14½ in	14¾ in	13 in	13 in	13 in	13½	13¾ in	14	14
Strength	2390#	2702#	2900#	2300#	2965#	2910#	3000#	2580	2420
Set	1/32 in	1/32 in	1/32 in	½ in	½ in	½ in	7/16 in	1/2	1/2
Color	~~Black~~	white	white	grey					
Date	8-25-17	8-25-17	8-29-17	9-4-17	11-15-17	11-16-17	11-16-17		
Remarks	4	4	4	4	4	4	4	aged 9 months air. 4	

NUMBER X 2058 MADE FOR Treatment of Sample Lot with Ale P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Caucho									
Guayule									
Hatsleva		93							
A			93						
B				93					
C					93				
D						93			
Whiting							93		
Tonolite									
Magnesia									
Black Lead									
Ulexa									
Barytes									
Al Flake									
Lime		1	1	1	1	1	1	1	1
Litharge		2	2	2	2	2	2	2	2
Sulphur		4	4	4	4	4	4	4	4
White Lead									
Zinc									
Total		100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices				1					
Cure		30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30
Stretch		9	9	8½	7½	9½	11	12	11
Strength		345	190	130	125	130	380	315	525
Set		1/16	1/32	0	1/64	1/4	1/16	1/16	1/16
Color									
Date		2-16-18	2-16-18	2-16-18	2-16-18				
Remarks									

Accelerators — Aeroplane Gasoline

NUMBER X 2059 MADE FOR Hose. P. O. ———

		A	B	C	D	E	F	G	H
S. Sheets	20		20.		50	50	50	50	50
Coarse									
Casabe									
Guayule									
Metho	7.	7.	7.	7					
Camsee	5.	5.	5.	5					
Glutan		32.							
M. & R.		5.							
Sinoplast				32					
BMR				5					
D									
F									
G									
Red Oxide		5.	3.	5					
Whiting	35.	13.	32.						
Magnesia	2.	2	2	2	2	2	2	2	2
Antimony	6.5	6.5	6.5	6½					
Al Flake				13					
Lime					1				
Litharge									
Sulphur				1	4	4	4	4	4
White Lead									
Zinc	10.	10.	10.	10	43	43	43	43	43
Tyrolith	14.5	14.5	14.5	14½					
Diffendo (pure)					1				
(35% Ox)						1			
" (14% Ox)							1		
" (3% Ox)								1	1
Total	100.0	100	100		100	100	100	100	100
Sp. Grav. Cost and Prices	Oxide + Co. Asph. Cut 3½ Oil Emulsion 1.2 1.35 2.9								
Cure	48@74°	48@74°	48@74°		20/30	20/30	25/30	20/30	
Stretch	8¾	9¾	9¼		14¼	16¼	14¾	14	
Strength	1125	1360	1540		3450	3490	2790	2580	
Set	9/32	11/32	9/32		3/4	5/8	7/8	7/16	
Color	Red	Red	Red						
Date	2-25-18	2-26-18	2-26-18	8-1-18	10-16-18	10-3-18	11-9-18	11-9-18	

Remarks — Ship. Est

Effect of Benzol and Accelerators in a Rubber Stock

NUMBER X 2060 MADE FOR ——— P. O. ———

		A	B	C	D	E	F	G	H
S. Sheets	50.	50	50	50	50	50			77.5
Coarse									
Casabe									
Guayule									
Accl #301		75							
Accl #305			75						
Accl #310				1					
A							88		
B							3		
C					1				
Frazer Dark									18
F									
G									
Diffendo (pure)					1				
Diffendo (35% Ox)						1	1	½	.5
Eltanga								43	
Magnesia	2.	2	2	2	2	2			
Al Flake								6	
Lime							2		
Litharge									
Sulphur	4.	4	4	4	4	4	6	7	
White Lead									
Zinc	43.	43	43	43	43	43			
Cmk C=OH	1							1	
Oleum								26¼	
Quartzine								16¼	
Celite									
Total		100	100	100	100	100	100		100
Sp. Grav. Cost and Prices							In negligible amt	Color STK	
Cure		50/40	50/40	30/40	20/30	20/30	49/45	35/35	
Stretch		14	16	14	14/15	14/14	19¼		
Strength		2975	3250	2975	3400	3420	26¼		
Set		7/8	13/16	7/8	3/4	7/8	23¼		
Color					White	White			
Date	9-6-18	11-13-18	11-13-18	11-11-18					

Remarks — Accelerator does not blister and tolerance from 2 min. to 5 min. cure

Cured 2 min. at 307° F. and aged 7 days at 158° F. Stopped cure

NUMBER X 2061 MADE FOR Comparison tests for different fabrics of Tennessee Rubber Co.

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Cambo									
Guayule	50								
A Brand " "		50							
Duck " "			50						
A									
B									
C									
D									
F									
G									
Al Flake	16	16	16						
Lime	2	2	2						
Litharge	8	8	8						
Sulphur	4	4	4						
White Lead									
Zinc	20	20	20						
~~Ultramarine~~	~~2~~								
Total	100	100	100						
Sp. Grav. Cost and Prices									
Cure	40/45"	40/30"	95/100						
Stretch	3½	4½	4						
Strength	1250	925	795						
Set	4/16	3/16	3/16						
Color									
Date	4-19-18	4-19-18	4-19-18						
Remarks									

NUMBER X 2062 MADE FOR Treatment of Sound Fabric and Cloth P O

		A	B	C	D	E	F	G	H
S. Sheets									
Coarse									
Cambo									
Guayule									
Fabric soap	85	85							
Pine Tar Oil	15	~~5~~							
Cotton seed oil		10							
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur									
White Lead									
Zinc									
Total	100	100							
Sp. Grav. Cost and Prices									
Cure	30/45	30/60	95/100	90/100					
Stretch	3½	3½	4	4¼					
Strength	745	660	585	545					
Set	1/32	1/32	2/32	1/8					
Color	Gray	Gray	Gray	Gray					
Date	May 15-18	May 15-18							
Remarks									

Comparison 2nd Grade American Zinc Lead & Smelting Co

NUMBER X 2063 MADE FOR + Std Sanitch P. O.

Comparison Lithopone from Mutual Chem. Co

NUMBER X 2064 MADE FOR Accelerators P O

		A	B	C	D	E	F	G	H
S. Sheets	50	50	50	50	50				
Ozone									
Ozonite									
Oxzyde									
A									
B									
C									
D									
F									
G									
Al Flake									
Lime	1	1	1	1	1				
Lithopone	4	4	4	4	4				
Sulphur									
White Lead									
Zinc			45 (illegible)	45 (illegible)	← 45				
Sanitch	45								
Lithopone Hand Blown		45							
Total	100	100	100	100	100				
Sp. Grav. Cost and Prices									
Ozone	50-50	50/40	75/40	75/40	75/40				
Stretch	17	16 1/4	15 1/4	15	15				
Strength	1655	1500	1800	1650	1680				
Set	11/16	9/16	5/8	5/8	3/8				
Color									
Date	9-29-19	9-29-19	10-6-19	10-6-19	10-6-19				
Remarks									

		A	B	C	D	E	F	G	H
S. Sheets									
Ozone									
Ozonite									
Oxzyde									
Zinzyn	57	1	1.5	88.6	50	50	93	55	
Hubbard Russell	1			1.5					
Titanox		89	88.5						55
A									
B									
C									
D									
F									
G									
Diffendo					1		1		
Al Flake									
Lime									
Lithopone	4	4	4	4		1		2	2
Sulphur	6	6	6	6	4	4	6	4	4
White Lead									
Zinc					43	43		39	39
Ozg.					2	2			
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Ozone	35/45	35/45	26	42	30/6	75/45	70/39	105/45	119/45
Stretch	20	17 1/2	Not enough	Not enough	14	11 1/2	19	14	11 1/2
Strength	2290	1130	Lithopone	Lithopone	2290	1810	2250	1810	985
Set	1/4	1/4			3/8	3/8	1/4	13/32	3/8
Color	Gray	Gray							
Date	10-1-19	10-1-19			10-3-19	10-3-19		11-4-19	11-4-19
Remarks									

NUMBER X 2065 MADE FOR Accelsitors P O

		A	B	C	D	E	F	G	H
S Sheets	5	6	6 1/2	6 0.7	30.5	2 3	5		
Coarse									
Couche	2 1/2	2	2 1/2	2 1.5					
Greyish									
Fourth	5								
Medium	10	10	10	10					
Fifth		2	1		15	15			
Fine Coarse					15				
B									
C									
D									
F									
Coarse						8			
Diffuse				3	5				
Medium Diffuse							7		
Al Flake									
Lime									
Litharge					7	7			
Sulphur	6 1/2	6 1/2	6 1/2	6.25	8	8	4		
White Lead									
Zinc					15	15	4 1/2		
Magnesium	1 1/2	1 1/2		1.25			2		
Calcite					36	24			
Total	25	25	100	100	100	100	100		
Sp. Grav. Cost and Prices									
Cure	65/53	65/53	65/53	65/53	65/53	65/53			
Stretch	15 1/2	15 1/2	10 1/2	9 1/2	11/4	43/4			
Strength	960	1500	1450	2450	2.75	2020	3		
Set	1/8	1/8	1/4	1/8	7/16	3/4	2		
Color									
Date	12-8-13	12-10-13	12-12-13	12-9-13	12-10-13	12-12-13			

Remarks

NUMBER X 2066 MADE FOR Accelsitors P O

		A	B	C	D	E	F	G	H
S Sheets	50	50	50	50	50	50			
Coarse									
Couche									
Greyish									
Diffuse (Coarse)	1								
" (Medium)		1							
" (Fine)			1						
" A (Fine)	1			1					
" B "	2				1				
" C "	3					1			
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur	4	4	4	4	4	4			
White Lead									
Zinc	43	43	43	43	43	43			
Whitfield	2	2	2	2	2	2			
Total	100	100	100	100	100	100			
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									

Remarks

NUMBER X 2067 MADE FOR P O

		A	B	C	D	E	F	G	H
S. Sheets		50							50
Coarse									
Carbo	50								
Guayule									
Sunnyside			50	~~50~~		50	50	50	
I A Cuba				50					
A									
B									
Shelby C					95				
D									
F									
G									
Vuelta Corro	1	1	1	1	½				
T P Pl						1			1
Tuxedo							1		
								1	
Al Flake									
Lime									
Litharge									
Sulphur	4	4	4	4	½	4	4	4	4
White Lead									
Zinc	43	43	43	43		43	43	43	43
Mag O	2	2	2	2		2	2	2	2
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure	50/40	50/40	50/40	39/40	5%0	12½	39/40	39/40	3460
Stretch	14¾	14¾	15½	14¼	9	15	14¾	14	15
Strength	1870	2740	2160	1750	630	2600	2000	3560	2300
Rat	¾	¾	½	½	½	½	½	¾	¾
Color	Light Gray	Light Gray	Light Gray	Light Gray	Red Gray	Light Gray	Light Gray	Light Gray	Light Gray
Date	4/28/40	4/22/40	4/27/40	4/20/40	4/24/40	4/26/40	4/25/40	4/27/40	4/27/40
Remarks									

NUMBER X 2068 MADE FOR P O

		A	B	C	D	E	F	G	H 208
S. Sheets									
Coarse									
Carbo	31½	31½	31½	31½		31½	31½	31½	
Sunnyside									52
Sunnyside	60½	60½	60½	60½	90	60½	60½	60½	
Amalgamated and Spanish Combination	½	½							
A Phillipine			½	½					
Wh Plate C P				½		½	½		
" " D. 9							½		
" " F. 1						½			
G								½	½
Tobacco Colonial					1¾				
Al Flake									
Lime									
Litharge									
Sulphur	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	5½
White Lead									
Zinc					1				5
Mag O	1¾	1¾	1¾	1¾	1¾	1¾	1¾	1¾	1
Silete									6
Total	100	100	100						
Sp. Grav. Cost and Prices									35:39 2460 15 ¼
Cure	95/296	75/296	75/296	45/50	25/50	40/50	40/50	45/50	35 30
Stretch	20			18	17	18	19¾	18	17
Strength	2280	1900	1900	3300	3200	2400	2700	2445	3560
Rat	¼			¼	¼	¾	¾	¼	5/8
Color	Lt	Dk	Dk	Light Gray	Black	Light Gray	Light Gray	Light Gray	Light
Date	5/5/40			5/5/40	5/4/40	5/1/40	5/10/40	5/14/40	5/16/40
Remarks									

NUMBER X 2069 MADE FOR Creelsboro P. O.

		A	B	C	D	E	F	G	H
R. Rhode		10				40			5%
Osarus									12
Oxalis									
Onaysis									
Georgia		30	50	50	40		82	82	15
[illegible]		10			10	10			
Allen		3							
A									
B									
C									
D									
F					½	½	½		½
[illegible]	Regular Treatment OKG	1							
[illegible]			5						
[illegible]				2					
[illegible]									
Al Flake		2	10	10	8	8½			
[illegible]						½	½		
[illegible]					5	5			1 Pkg
Sulphur		3	3	3	3	3	3	3	5
[illegible]							7	7	
Zinc		10	10	10	10	10	1	1	2
Pkg 3		1					1	1	2
Sunshine		20	20	20	18	18	Sold out		
Soluble		10							
MAX			5	5	5	5			
Nephalene					½	½			
Total		100	103	100	100		100	100	
Sp. Grav. Cost and Prices		65/5 30-37 5 10 930 1900 ½ ⅛	[illegible]	[illegible]					
Cure		65/53	30/37	[illegible]					
Strength		9800	3100	2700-2800	3000				
Set		7 ⅛	1⅛	1" - 1	1				
Color		Black	Black	Black	Black	Black	Red	Red	
Date		5/24/20	6/23/20	7/26/20	8/13	8/13	6/22	7/22	4/26 - 1923

Remarks

NUMBER X 2070 MADE FOR Red Tanks P. O.

Wheeling & Blue Rock Clay

		A	B	C	D	E	F	G	H
R. Rhode	50	50	50						
Osarus									
Oxalis									
Onaysis									
Georgia				82	92	92	82	82	
[illegible]				½	½				
[illegible]				½					
A									
B									
C									
D									
F									
G									
[illegible]						1			
MAYC							1	1	
[illegible]				½	½ 6	½ 6	½ 6	6	
Al Flake									
Lime	1	1	1						
Litharge									
Sulphur	4	4	4	3	5½	5½	5½	5½	
White Lead									
Zinc		[illegible]		1	5	5	5	5	
[illegible]		45							
Blue Rock Clay			45	7					
[illegible]				1					
Pkg 0				1	1	1	1	1	
Red Devil				5					
Total				100	100	100½	100½		
Sp. Grav. Cost and Prices	[illegible]								
Cure	50/40	50/40	50/40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Strength	1350	1400	1230	2130-2200	4050	2700-3300	1700-2700	3200	
Set	½	½	5/8	¼ ⅝	½	¼ - ⅝	¼ ½	⅝	
Color				Red	Clay	Clay	Clay		
Date	5/26-27	5-26-20	5-26-20	6/24	6/24/20	6/9/20	6/9/20	6/20/20	

Remarks

Comparison below Znox Sebic

NUMBER X 2071 MADE FOR _____ P. O. _____

		A	B	C	D	E	F	G	H
S. Sheets	43	43							
Cosmo									
Cascho									
Guayule									
A									
B									
C									
D									
F									
G									
Al Flake									
Lime									
Litharge									
Sulphur	3	3							
White Lead	6	6							
Zinc	40	40							
Sebic	8	8							
Total	100	100							
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

NUMBER X 2072 MADE FOR _____ P O _____

		A	B	C	D	E	F	G	H
S. Sheets	81	81	81	81	81	81	81	81	81
Cosmo									
Cascho									
Guayule			53	81					
A			Blank	5½					
B				6½					
C				6½					
D									
F									
G									
Crowite	½						¼	¼	
Sulphur		½					¼		
Diphenyl			½					¼	¼
Mexa									
Al Flake	Para Red				½				½
Lime	½	½	½		½	½	½	½	½
Litharge									
Sulphur	5½	5½	5½		5½	5½	5½	5½	5½
White Lead									
Zinc	6½	6½	6½		6½	6½	6½	6½	6½
Inertia	6	6	6		6	6	6	6	6
Total	100	100	100	100	100	100	100	100	100
Sp. Grav. Cost and Prices									
Cure									
Stretch									
Strength									
Set									
Color									
Date									
Remarks									

aging of Asbestos Covers

NUMBER X 2073 MADE FOR _____ P O _____

		A	B	C	D	E	F	G	H
S. Shoots	81	81	81	81	81				
Coarse									
Caorbo									
Guayule									
Diaphor	1/2	1/4	1/4	1/8	3/4				
Paraffine		5							
Pd Lin		1/4							
A									
B									
C									
D									
F									
G									
Formaldehyde Asb	1/4								
Dixie Clay			1/4	3/8					
Al Flake									
Lime	1/2	1/2	1/2	1/2	1/2				
Litharge									
Sulphur	5 1/2	5 1/2	5 1/2	5 1/2	5 1/2				
White Lead									
Zinc	1 3/4	6 1/2	6 1/2	6 1/2	6 1/4				
Inerton	6	6	6	6	6				
Mg O	1								
	100	100	100	100	100				
Sp. Grav. Cost and Prices	N G	N G	N G	N G	N G				

Cure
Stretch
Strength
Set
Color
Date

Remarks

NUMBER X 2074 MADE FOR _____ P O _____

	2074 P.J.Z	A	B	C	D	E	F	G	H
S. Shoots	15			15			15		
Coarse									
Caorbo									
Guayule									
Diaphor	19 1/2	10	10	19 1/2	10	10 1/2	19 1/2	20	
Batanga								15	
Wotomin		30	30		40	40			
A									
B									
C		31 1/2	36 1/2		30		40		
D									
F									
Crayllbond	40			40		30		43	
Arama	1			1			1		
Paraffin				1 1/2				2	
B.U.R	5	10	15	3	5	5	4		
Al Flake									
Lime	1			1		1	1	1	
Litharge	8	5	5	5	5	5	8	5	
Sulphur	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3	
White Lead									
Zinc	7	10	10	7 1/2	6 1/2	5	7	8	
Ferrite						Tasheet		PS K	
	=P.J.Z								
Total	100	100	100	100	100	100	100	100	
Vol Pounds	(Light)							55	
Sp. Grav. Cost and Prices	1.34	1.43	1.45	1.32	1.43	1.41		1.33	
	13 12	10.04	10.29	13 26	0976	0982		1251	
cu ft	10.96	9.41	950	10.90	8.71	865		10.52	
Cure	35/274	35/274	35/274	35/274	30/274	30/274	30/274	30/274	
Stretch	1350	13	12 1/2	12 1/2	17 1/2	12 1/2	12 1/2	12 1/8	
Strength	1450	1335	165	900	1007	1165	1240	940	
Set	3/4	7/8	7/8	7/8	1	1	7/8	7/8	
Color									
Date	1-2-22				2-22	2-9-22		2-22-22	

Remarks P.J.Z Asphaltic cement 24 # PAR

THE ACTION OF CERTAIN ORGANIC ACCELERATORS IN THE VULCANIZATION OF RUBBER—III[1]

By G. D. Kratz, A. H. Flower and B. J. Shapiro[2]

It has for some time been generally recognized that although aniline is effective as an accelerator in the absence of zinc oxide, diphenylthiourea functions but mildly in the absence of, and strongly in the presence of this substance. Reference to this effect has already been made indirectly in the literature several times, and recently Twiss[3] has given curves for physical test results which demonstrate quite clearly the effectiveness of diphenylthiourea as an accelerator in the presence of zinc oxide. His statement that diphenylthiourea is practically inert in the absence of zinc oxide is, however, not in accord with our findings.

In a previous paper of this series[4] we have shown that in the acceleration of the vulcanization of a rubber-sulphur mixture, the activity of one molecular part of diphenylthiourea is less than that of an equimolecular quantity of aniline, but equal to that of one molecular part of aniline and one molecular part of phenyl mustard oil.

Our former experiments, however, were confined to the determination of sulphur coefficients at one cure only. In the present instance, we desired to compare the relative effects of aniline and diphenylthiourea over a series of cures, and to effect this comparison both by means of the sulphur coefficients and the physical properties of the various mixtures and cures. Further, it was desired to compare mixtures which contained zinc oxide, as well as the rubber-sulphur mixtures previously employed.

Summarizing our results briefly, we found that, in a rubber-sulphur mixture, the accelerating effect of aniline is considerably greater than that of diphenylthiourea, when judged either by sulphur coefficients or on the basis of the physical properties of the vulcanized mixtures. In mixtures which contained zinc oxide, however, the reverse was found to be true, and diphenylthiourea was more active than aniline when judged by either of the above criteria. It was also evident that in the case of the mixtures which contained zinc oxide, although the tensile strength of the mixture which was accelerated by diphenylthiourea increased more rapidly than in the case of the mixture accelerated by aniline, the same maximum tensile strength was attained by each. The sulphur coefficients at their respective maxima were practically identical. While the maximum tensile strength of the rubber-sulphur mixture which was accelerated by aniline was the same as that obtained when zinc oxide was present in the mixture, it was attained only at a much higher sulphur coefficient. Lastly, it was also found that the tensile strengths of the mixtures that contained zinc oxide and which were accelerated by either aniline or diphenylthiourea, particularly the latter, were increased tremendously during the first part of the vulcanization, and at very low sulphur coefficients. This would indicate the possibility of certain substances (accelerators) increasing the physical properties of a vulcanized mixture without greatly affecting the sulphur coefficient.

This point is of interest as it already has been noted by ourselves,[4] Cranor,[6] and others, that with mixtures which contain zinc oxide and a strong organic accelerator, the correct (or optimum) cure is obtained at abnormally low sulphur coefficients when compared with those obtained for unaccelerated mixtures. No explanation has been offered for this phenomenon. Bedford and Scott,[7] however, regard diphenylthiourea as the aniline salt of phenyldithiocarbamic acid after H_2S has been liberated. This salt is extremely unstable, owing to the weakly basic properties of aniline, and in this respect, according to Krulla,[8] is unlike the metallic salts of the same acid. In this connection, it is particularly pertinent to note that Bruni[9] has recently found the zinc salts of the mono and disubstituted dithiocarbamic acids to be violent accelerators. It is quite possible, then, that such a salt may be formed during the vulcanization process in mixtures which contain both diphenylthiourea and zinc oxide,[10] and that, irrespective of its action as an accelerator, the zinc portion of such a salt may be responsible for the physical improvement imparted to the mixture.

Our present results, moreover, particularly when interpreted with the assistance of the excess sulphur coefficients obtained for the various mixtures at different times of cure, show that when aniline is employed as the accelerator in the presence of zinc oxide, the effect of the latter substance is manifested almost entirely in the physical properties of the mixture. When aniline is replaced by diphenylthiourea the reverse is true, and the activity of the original substance as an accelerator is greatly increased when measured by either the sulphur coefficients or physical properties. In the latter instance, then, the zinc oxide most probably either assists in the decomposition of the diphenylthiourea

[1] Presented before the Rubber Division of the American Chemical Society, Chicago, Ill., September 6 to 10, 1920.
[2] The Falls Rubber Co., Cuyahoga Falls, Ohio.
[3] Journal of the Society of Chemical Industry, 39, 1920, 125t.
[4] Journal of Industrial and Engineering Chemistry, 12, 1920, 317.
[5] Journal of Industrial and Engineering Chemistry, 11, 1919, 39; Chemical & Metallurgical Engineering, 20, 1919, 418.
[6] The India Rubber World, 61, 1919, 367.
[7] Journal of Industrial and Engineering Chemistry, 12, 1920, 31.
[8] Ber., 46, 2869.
[9] British Patents Nos. 140,387 and 140,389.
[10] The action of diphenylthiourea with zinc oxide is apparently similar to the action of the natural accelerator with magnesium oxide, as pointed out in a previous paper (Journal of Industrial and Engineering Chemistry, 12, 1920, 971). In both cases the oxide serves in a counterbalancing capacity rather than as a primary accelerator. It is obvious that no one oxide will activate all accelerators equally well.

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to a more active substance, or combines with the decomposition or alteration products of the original substance with the formation of a zinc salt, which is responsible for the increase both in the sulphur coefficients and tensile strength of the mixture. Our results with aniline as the accelerator, however, do not indicate the formation of such a salt.

Thus, in the presence of zinc oxide, the activity of aniline and diphenylthiourea as accelerators appears to be of a different nature. Evidently, an acid substance, probably a thiocarbamic acid, capable of reacting with zinc oxide, is formed as one of the decomposition products of diphenylthiourea. The excess accelerating activity is attributed to this zinc salt. When aniline is employed as the accelerator, there is no evidence of such salt formation.

EXPERIMENTAL PART

The present experiments were designed to effect a comparison of the sulphur coefficients and physical properties of representative mixtures when accelerated by 0.01-gram-molecular quantities of either aniline or diphenylthiourea. The six following mixtures were employed for this purpose, and each was vulcanized for a series of cures:

A—Rubber-sulphur control
B—Rubber, sulphur, and aniline
B 1—Rubber, sulphur, and diphenylthiourea
C—Rubber, sulphur, and zinc oxide control
D—Rubber, sulphur, zinc oxide and aniline
D 1—Rubber, sulphur, zinc oxide, and diphenylthiourea

The quantities of each substance employed in these mixtures are shown in Table I. The amounts of aniline or diphenylthiourea added to these respective mixtures represent 0.01 gram-molecule of the accelerator for each 100 gms of rubber in the mixture. Otherwise, the same general method of procedure was adopted in the course of this work as in that previously reported in Part I.[11]

The rubber used was of good quality, first latex, pale crepe, a different sample of the lot used in our former experiments. The various mixtures were mixed on the mill, vulcanized, and tested in the same manner as before. The physical properties of the vulcanized samples were determined on a Scott testing machine of the vertical type, with the jaws opening at the rate of .20 inches per minute. A recovery period of 48 hours was allowed before physical tests were made. Combined sulphur was estimated by our method previously reported in detail.[12]

The various mixtures were vulcanized at 141.5 degrees C. for different intervals of time up to 240 minutes.[13] The sulphur coefficients and physical properties of the different cures for each mixture were determined. These results are given in detail in Table II. Generally speaking, the results obtained were in good agreement, and fairly smooth curves for physical properties were obtained.[14]

Table I

Ingredient	Mixture A	Mixture B	Mixture C	Mixture D	Mixture B 1	Mixture D 1
Rubber	100.00	100.00	100.00	100.00	100.00	100.00
Zinc oxide	....	....	100.00	100.00	....	100.00
Sulphur	8 1	8 1	8 1	8 1	8 1	8 1
Aniline	....	0.93	....	0.93	....	....
Diphenylthiourea	....	....	....	....	2.28	2.28

Table II

(All Mixtures Vulcanized at 141.5° C.)

Cure in Minutes	Mixture A: Sulphur Coefficient	Mixture A: Tensile Strength, Lbs. per sq. in. at Break	Mixture A: Final Length at Break Per Cent	Mixture B: Sulphur Coefficient	Mixture B: Tensile Strength, Lbs. per sq. in. at Break	Mixture B: Final Length at Break Per cent	Mixture C: Sulphur Coefficient	Mixture C: Tensile Strength, Lbs. per sq. in. at Break	Mixture C: Final Length at Break Per Cent	Mixture D: Sulphur Coefficient	Mixture D: Tensile Strength, Lbs. per sq. in. at Break	Mixture D: Final Length at Break Per Cent	Mixture B 1: Sulphur Coefficient	Mixture B 1: Tensile Strength, Lbs. per sq. in. at Break	Mixture B 1: Final Length at Break Per Cent	Mixture D 1: Sulphur Coefficient	Mixture D 1: Tensile Strength, Lbs. per sq. in. at Break	Mixture D 1: Final Length at Break Per Cent
30	0.754	....	....	1.176	545	1180	1.005	....	....	1.431	510	710	0.913	(1)	1210	1.603	2219	820
45	0.936	279	1250	1.317	1019	1170	1.055	306	640	1.490	1356	720	1.063	(1)	1360	1.912	3391	780
60	1.038	....	....	1.563	1228	1120	1.207	392	750	1.628	1819	770	1.335	(1)	1280	2.297	4442	790
75	1.090	494	1220	1.898	....	....	....	....	....	....	1968	750	1.809	533	1230	2.623	....	....
90	1.531	709	1150	2.182	1621	1060	1.338	1041	700	2.382	2350	720	1.953	789	1220	2.962	2730	830
120	2.069	871	1160	2.351	2046	1190	1.765	1815	780	2.801	2908	780	2.496	1053	1210	3.755	2699	778
150	2.256	1159	1130	4.033	2410	1190	2.217	1970	760	3.266	3721	770	3.109	1303	1150	4.521	2619	750
180	2.470	1321	1130	6.939	2670	1030	2.630	2032	750	4.226	3663	740	4.027	1779	1110	5.357	2030	690
210	3.179	1842	1100	5.264	2760	970	3.246	2184	760	4.906	2545	700	4.730	2021	1080	6.379	1118	530
240	3.751	2124	1060	6.268	2131	910	3.615	1978	730	5.364	1837	680	5.624	2362	1050	7.079	754	440

(1) Test pieces did not break.

(2) In mixtures which contain zinc oxide, diphenylthiourea is more active than aniline.

(3) In mixtures accelerated by aniline, either with or without zinc oxide, the same maximum tensile strength is obtained, accompanied by a higher sulphur coefficient in the absence of zinc oxide than when this substance is present.

(4) Mixtures which contain zinc oxide, and which are accelerated by either aniline or diphenylthiourea, show large increases in tensile strength in the early stages of the vulcanization.

(5) Mixtures which contain zinc oxide and which are accelerated by either aniline or diphenylthiourea, attain the same maximum tensile strength at approximately the same sulphur coefficients.

(6) There is apparently no general relation between the physical properties and sulphur coefficients of accelerated mixtures.

[11] Journal of Industrial and Engineering Chemistry, 12, 1920, 317.
[12] The India Rubber World, 61, 1920, 356.
[13] In the experiments described in Parts I and II vulcanization was carried on at a temperature of 140 degrees C.
[14] Satisfactory physical test results for representation graphically are obtainable with considerable difficulty. We have found it necessary, particularly when working on stress-strain diagrams, to employ three men, one to operate the machine and two to take readings.

CONCLUSIONS

(1) In a rubber-sulphur mixture, the activity of aniline in the acceleration of vulcanization is much greater than that of a molecularly equivalent quantity of diphenylthiourea.

SHIPPING SERVICE TO RHINE POINTS RESUMED

The Red Star Line of the International Mercantile Marine Co., New York, N. Y., announces resumption of its pre-war all-water service to points on the River Rhine. Transhipment via fast Antwerp steamers may be made for both incoming and outgoing traffic. Through rates will now be named and through bills of lading issued. Goods for France, Alsace-Lorraine and the district of the Saar may be shipped via Strasburg without assessment of the French Customs surtax. Rates will also be named for rail shipments via Antwerp and Thionville to and from the Rhine Valley, Switzerland, France and inland points in Belgium for handling classes of cargo requiring rail transportation. This restores Antwerp as a shipping point for the territory in question to the same favorable position it held before the war.

Plaintiff's Exhibit No. 11 (Page

T #8

First Lilac	27	0
Sheets	27	- 0
Shd	17	- 13
Brown Lub	7	- 0
M R	7	- 0
Zinc	1	- 12
Blanc Fixe	5	- 6
Sul	5	- 6
# 4 Black	0	- 5
H. Magnesia	0	- 8
Paraffin	0	- 14
	100	

Plff. Exhibit #13
Oct. 15/25
Mills

PLAINTIFF'S EXHIBIT No. 14

IN THE UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK

In Equity. No. 24-23

DOVAN CHEMICAL CORPORATION, Plaintiff,

vs.

NATIONAL ANILINE CHEMICAL COMPANY, INC., Defendant

Weiss Patent No. 1,411,231

Affidavit of Clinton A. Carlton

STATE OF OHIO,
County of Richland, ss:

Clinton A. Carlton, being duly sworn, deposes and says as follows:

I am of mature age and reside in Mansfield, County of Richland, State of Ohio. I am employed as Chemist at the Works of the Columbia Tire & Rubber Company, Mansfield, Ohio. I am a graduate of the University of Akron, in the City of Akron, Ohio, at which place I obtained the degree of B. S. in Chemistry in 1917. Immediately after graduating from said University, I was employed by the Republic Rubber Company of Youngstown, Ohio, at which place my work commenced in June of 1917. At the commencement of my work with the Republic Rubber Company, I found it necessary to put the chemical laboratory in better condition for analytical work, and, therefore, immediately ordered various materials and supplies. During my employment at the Republic Rubber Company I was under the direction of Monroe H. Daniels, who was Chief Chemist for said company and was associated with Mr. Morris L. Weiss in connection with my work relating to the preparation and analyses of organic compounds.

At various times during my connection with the Republic Rubber Company of Youngston, Ohio, I had various talks with said Morris L. Weiss concerning accelerators. During one or more of these talks, Mr. Weiss referred to dy-

phenylguanidine which he considered would probably be a good accelerator because it was more basic than triphenylguanidine, with which I had previously been somewhat familiar. In this connection, Mr. Weiss showed me a copy of Richter's Organic Chemistry, to which we had access at the plant of the Republic Rubber Company, and called my attention to a page in said Chemistry which mentioned dyphenylguanidine simply as a known organic compound capable of being produced in a chemical laboratory. This fact serves to fix in my memory the fact that said Morris L. Weiss suggested to me the use of such dyphenylguanidine as an accelerator during my employment with the said Republic Rubber Company. I agreed with Mr. Weiss that it would be worth while testing dyphenylguanidine as an accelator and stated that I thought it would be well for him to proceed with said tests.

I left the employ of the Republic Rubber Company on March 8, 1918, because of the fact that I had been inducted into the Engineers Enlisted Reserve Corps of the United States Army on account of the war conditions which existed at that time, and was temporarily assigned to the University of Akron for the teaching of organic chemistry.

To the best of my knowledge, information and belief, Corl H. Eaton, whom I understand has previously made an affidavit in this cause, was not employed at the Republic Rubber Company during my connection with said company and understand that he entered the employ of said Republic Rubber Company in October 1918, as stated in his affidavit.

At the request of a person whom I understand was a representative of the defendant in this case, I made an affidavit dated June 3, 1922, and the statements made therein are true to the best of my knowledge, information and belief. Said affidavit, however, is not to be interpreted to the effect that Morris L. Weiss did not originally bring to my attention the possible use of dyphenylguanidine as an accelerator.

While employed at the Republic Rubber Company at Youngstown, Ohio, I was acquainted with Carl H. Zieme, but said Zieme was employed in the Hose Department of the Republic Rubber Company and was not in touch with the working of the chemical laboratory or the work undertaken by myself or said Weiss.

According to the best of my knowledge, information and belief, Morris L. Weiss is the first and original inventor of the use of dyphenylguanidine as an accelerator in the vulcanization of rubber and its production in commercial quantities for that purpose.

The above facts were recalled to my mind by a conversation with Mr. Morris L. Weiss at the time of the meeting of the American Chemical Society in Pittsburgh, Pennsylvania, during the first week in September, 1922.

Clinton A. Carlton.

Sworn to and subscribed before me this 7th day of November, 1922. Charles W. Chew, Notary Public, Richland Co., Ohio. Com. expires 12/18/24.

PLAINTIFF'S EXHIBIT No. 17

Report

Name of Co.: Perth Amboy Chemical Works.
Department: Rubber Laboratory.
Subject: Report of proceedings at the Rubber Division Meetings of The American Chemical Society held in Philadelphia—September 3, 4, and 5th.
Author: C. S. Williams.
Date: September 8, 1919.

The writer attended all of the meetings of the Rubber Section and heard practically all of the papers which were read. The majority of these were only of general interest and did not bear directly on our products. The papers of special interest were as follows:

1. J. H. Scott—Action of Accelerators during vulcanization.

This paper dealt primarily with inorganic accelerators.

2. G. D. Kratz, A. H. Flower and Cole Coolidge—Action of certain organic accelerators in the vulcanization of rubber.

This paper was of particular interest in that the writers attempted to explain the action of Hexamethylenetetramine during vulcanization. According to their theory, Hexa-

methylenetetramine is converted during vulcanization into Di-thiourea which is the accelerating agent. They also stated that the action of Formaldehyde Aniline was due to the formation of Thiocarbanilid during vulcanization. The writer wishes to remark that his work with Formaldehyde Aniline and Thiocarbanilid does not confirm the statement of the above authors.

3. C. W. Bedford and Winfield Scott—Reactions of Accelerators during vulcanization.

The authors of this paper stated that the most widely used of all accelerators at the present time was Thiocarbanilid. This paper dealt with the chemical reactions involved during vulcanization.

4. D. F. Cranor—The effect of organic acceleration on the vulcanization coefficient.

This paper was quite academic. An attempt was made to show that the desired vulcanization coefficient was produced in a shorter time with the use of accelerators than without. Mr. Cranor's experiments as reported in this paper compared a control sample with a sample cured with Hexamethylenetetramine and a sample cured with one of the Bayer accelerators. This author informed the writer that it was impossible to use Hexa without the aid of Zinc Oxide. It is impossible to conceive how he arrived at this conclusion since we have found the contrary to be true at our laboratory.

The symposium on the action of accelerators which followed was unimportant as everyone seemed to try to conceal all he knew on the subject but obtained all the information possible from the others.

An interesting industrial trip was made by some of the members of the section, including the writer, to the Lee Tire & Rubber Company, Spring Mill, Pa.

The general outlook for accelerators was quite favorable and it was evident that everyone there realized the necessity of accelerators in all classes of rubber goods. The opinion was expressed that the rubber business during the coming year would be much larger than last year. It was stated that the index for the rubber business is the volume of manufacture in the automobile industry.

The chief value of the meetings which the writer attended lay in the fact that he was able to meet many of the well

known rubber men some of whom are our regular customers and some who we hope to have as customers.

Respectfully submitted.

C. S. W.

CSW/LK.

PLAINTIFF'S EXHIBIT No. 19

American Chemical Journal, 1901—v. 26

Oxygen Ethers of the Ureas

Ethyl phenylisourea, after having been in contact with concentrated aqueous ammonia for two months at the room temperature, was recovered unchanged.

No action could be detected after heating the urea ether in a sealed tube with alcoholic ammonia for three hours at 140°, the urea ether being again entirely recovered.

If ammonia reacted with ethyl phenylisourea according to the above equation, monophenylguanidine would be one of the products. Feuerlein[1] has described a substance as monophenylguanidine, but the properties given are not those one would expect a guanidine to have.[2] For fear from lack of exact knowledge concerning its properties of overlooking the base if it had been formed only in small quantity, it seemed best to prepare the guanidine synthetically. Even after becoming familiar with its properties none could be found when phenylisourea was treated with ammonia.

Monophenylguanidine, $C_6H_5NHC(:NH)NH_2$.—Equivalent amounts of cyanamide and aniline hydrochloride were placed in a sealed tube with double the weight of absolute alcohol and heated at 100° for two and a half hours. The tube opened with no pressure. Its contents were evaporated on the water-bath nearly to dryness and redissolved in a little water. Addition of a concentrated solution of potassium hydroxide caused the guanidine to separate as an oil, which soon solidified and was then filtered off. The yield was excellent.

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[1] Ber. d. chem. Ges., 12, 1002.

[2] Judging from the properties Feuerlein gives, the body he had was possibly the ammonium salt of phenylcyanamide.

Monophenylguanidine is soluble in water, alcohol, ether, warm chloroform, and warm benzene. Crystallized from the last solvent it melted at about 66°.[3] It decomposes on attempting to distil it in vacuo. The free base is hygroscopic and takes up carbon dioxide; for identification the chlorplatinate and benzoyl derivatives were prepared and analyzed.

Monophenylguanidine Chlorplatinate,[4] $(C_7H_9N_3)_2Pt_2Cl_6$.—Alcoholic solutions of monophenylguanidine and chlorplatinic

[3] Feuerlein could not have had monophenylguanidine, for he describes the body as exploding when heated.

[4] Feuerlein states that monophenylguanidine does not form a chlorplatinate.

Plaintiff's Exhibit No. 20 64

Plaintiff Exhibit No. 20-8/24/25-1915

CONSOLIDATION OF TABLES 1 AND 2 OF KRATZ'

PHILADELPHIA PAPER	AMOUNTS	PERCENT OR RUBBER	AMOUNTS CORRESPONDING TO 2% OF D.P.G. ON THE RUBBER	AMOUNTS CORRESPONDING TO 3% OF D.P.G. ON THE RUBBER
ANILINE	1.00	1.08	24.0	8.21
UREA	0.25	0.27	6.5	2.05
THIOUREA	0.30	0.324	7.8	2.46
MONO PHENYL THIOUREA	0.45	0.486	11.7	3.69
DI " " (THIOCARBANALIDE)	0.85	0.919	22.1	6.98
MONO PHENYL GUANIDINE	0.075	0.081	1.95	0.62
DI " "	0.075	0.081	1.95	0.62
TRI " "	0.30	0.54	13.0	4.10
ANHYDROFORMALDEHYDE ANILINE	0.75	0.81	11.25	6.28
p-PHENYLENE DIAMINE	0.17	0.183	4.42	1.40
MONOANHYDRO-FORMALDEHYDE p-PHENYLENE DIAMINE	0.14	0.151	3.64	1.15
DI " " " " "	0.14	0.151	3.64	1.15

FORMULA

RUBBER	92.5
SULFUR	7.5

KEUFFEL & ESSER CO., NEW YORK NO. 359 S.

	TABLE I	TABLE IV	
	% EQUIVALENT	% USED	COMBINED SULPHUR COEFFICIENT
ANILINE	1.00	.41	3.625
DIPHENYLTHIOUREA	.85	1.00	3.078
TRIPHENYL GUANIDINE	.50	1.25	3.872

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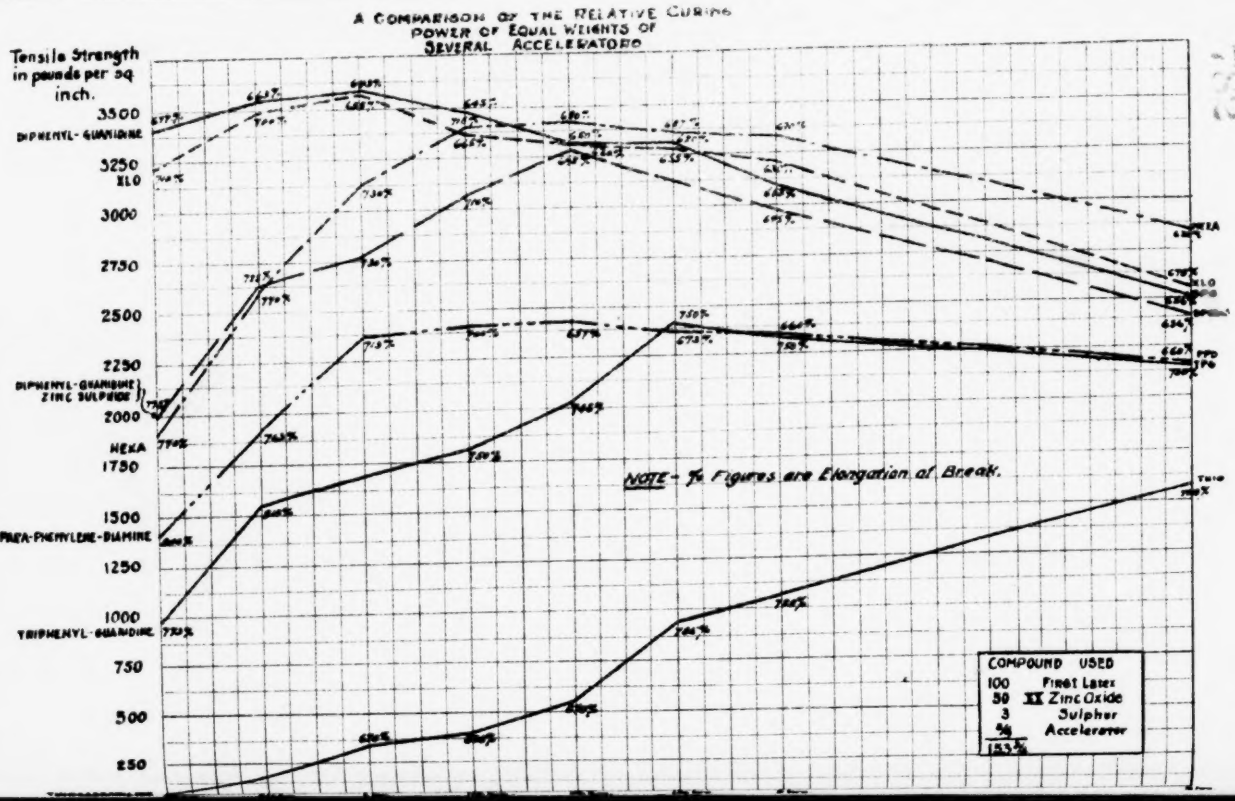
	Guanidine	DPG	TPG	Diorthotolyguanidine
	$NH:C(NH_2)(NH_2)$	$NH:C(NH\cdot C_6H_5)(NH\cdot C_6H_5)$	$C_6H_5N:C(NH\cdot C_6H_5)(NH\cdot C_6H_5)$	$NH:C(NH.NH_2)(NH_2)$
I	$CH_3NH.CS.SC_6H_5$	– a super-accelerator		
	$CH_3NH.CS.SC_6H_5$	– a very weak accelerator		
II	$CH_3(C_6H_5)N.CS.S_2.CS.N(CH_3)C_6H_5$	– a super-accelerator		
	$CH_3NH.CS.S_2.CS.NHCH_3$	– ~~practically~~ hardly any accelerating power		
III	$C_6H_5.NH.NH.C_6H_5$	– ~~retards~~ accelerates vulcanization		
	$C_6H_5NH.NH_2$	– retards "		
IV	$(CH_3)_2N.CS.S_2.CS.N(CH_3)_2$	– Tetramethyl Thiuram disulphide a super-accelerator		
	$CH_3N:C(SCH_3).S_2.C(SCH_3):NCH_3$	Tetramethyl Isothiuram disulphide		
	No accelerating action			
V	$CH_3CH(OH)NH_2$	– ~~no good~~ accelerator		
	$CH_2(CH_2OH)$	– not an accelerator		
VI	$OH.CH_2NH_2$	– an accelerator		
	$OH.C_6H_4$	– a retardant		

(Times, Review of Rubber, April 1920)

CHART SHOWING THAT THE INFLUENCE OF A CHANGE IN THE SUBSTITUTION CANNOT BE PREDICTED

Pfleiderer #31
Oct/25 "

Plaintiff's Exhibit No. 22



"6933.1"

The Effect of Organic Accelerators on the Vulcanization Coefficient.[1]

By D. F. Cranor.

A brief discussion of the already published work on the relationship of the mechanical properties of vulcanized rubber to the chemical composition, and a description of experiments with certain powerful accelerators which demonstrates that under certain conditions good mechanical properties can be obtained in rubber with a very low degree of chemical combination of sulphur

DURING THE PAST FEW YEARS considerable material has been published regarding the relationship of the mechanical properties to the chemical composition of vulcanized rubber. It has been demonstrated that if vulcanization is carried to a point where maximum physical properties are obtained in the freshly cured goods, such goods are overvulcanized and subject to rapid deterioration; also, that the proper degree of vulcanization for soft rubber can be accomplished with less chemical combination of sulphur in the case of quick curing stocks than with compounds which require prolonged heating to effect vulcanization. It is apparently quite generally believed that the coefficient of vulcanization for a properly cured pure gum mixing of good quality plantation *Hevea* rubber lies in the neighborhood of three; although it has been impossible to determine a coefficient which definitely represents the so-called optimum cure.

The fact that almost all practical rubber formulas to-day contain some one of the many organic accelerators makes further research necessary if scientific methods are to be applied to the estimation of the degree of cure of the mixings containing these substances. I have, therefore, undertaken extended work along these lines with view to making my testing methods more accurate and satisfactory. It has been the thought of the writer that results of greatest significance would be such as would indicate the amount of sulphur combination required to effect proper cure in a given sample of crude rubber, as compared with the combination necessary when the same rubber has added to it organic accelerators of various degrees of efficiency. Accordingly I have determined the physical properties and vulcanization coefficients of various samples of crude rubbers, when cured with and without accelerators, and have chosen certain series covering some of the results obtained in connection with powerful accelerators.

The determinations here described were made upon a mixing of standard rubber smoked sheet and a sample of inferior brown plantation crepe. In both cases 100 parts of rubber were mixed with 6 parts of sulphur and 1 of zinc oxide. The latter was included in order to have the compound workable to best advantage with accelerators which exert a maximum effect only when used in the presence of zinc oxide. The sulphur was set at 6 per cent on the weight of rubber, it being desired to use enough to get a stock capable of being overcured before showing the phenomena of reversion, which has been mentioned by Schidrowitz, and at the same time one in which the amount of sulphur is sufficiently low to obviate acceleration due to an excess, thus allowing the effect of the catalysts to be most clearly demonstrated. The percentage of zinc oxide is held at a maximum, it being used only to activate the accelerators added to these mixings. Even such an amount exerts a slight retarding action on the combination of sulphur, this having been proved by Van Heurn (See THE INDIA RUBBER WORLD, page 251, February 1 1919) and also by personal experience in our laboratory. This substance is also a factor in fixing the physical properties of the product, but it is necessary to include it in the basic formula in order to preserve the similarity of these mixtures with the treated compounds.

It will be noted by referring to Table I that the smoked sheet was vulcanized through a wide range of time changes at a vulcanizing temperature of 292 degrees F., or approximately forty-five pounds' steam pressure. All test specimens were cut by a die from sheets approximately 0.100 inch thick, which were vulcanized in an ordinary platen press, the temperature of which was controlled by a reducing valve. The tensile strength, ultimate elongation and loads required to produce definite elongations were determined by a Scott vertical combination rubber and fabric testing machine, the pulling jaw of which travels at a uniform rate of 20 inches per minute. The tensile product was calculated according to the method of Stevens. "Set" was determined in the case of the results recorded in Table I by stretching the specimen from one to eight inches and holding at such a setting for a period of ten minutes. The measurements were made ten minutes after releasing the samples from the jaws of the stretching device.

In the following tables the samples used for the "set" test were also stretched to eight inches, except in series where the figures for ultimate elongation are less than one to nine, in which case the samples for "set" were stretched from one to seven inches. As a matter of fact, practically no value is to be attached to the "set" results, as in many cases the figures are identical for samples having otherwise widely vary characteristics. They are inserted only to make the results complete, since the test is one which seems to be much used in general testing practice. The coefficient of vulcanization has in every instance been calculated from a direct determination of combined sulphur, made upon a sample extracted in acetone for a period of 24 hours at the boiling temperature of the solvent. The method used is the nitrate acid-bromine oxidation followed by fusion with potassium nitrate in presence of sodium carbonate. Two determinations were made upon each sample, and in almost every case the results check to within 0.10 per cent.

TABLE I.

COMPOUND A. UNTREATED SMOKED SHEET. PHYSICAL TEST VALUES AND COEFFICIENTS OF VULCANIZATION.

Minutes Curing at 292° F.	Tensile Strength Lbs. per Sq. In.	Set	Ultimate Elongation Inches	Tensile Product	Load 300% Elongation Lbs. per Sq. In.	Load 500% Elongation Lbs. per Sq. In.	Coefficient of Vulcanization
45	1616	1 to 9	8	1492	583	1060	1.23
100	1846	9	8	1519	570	1230	1.77
115	1788	9	8	1650	660	1215	2.01
130	1974	9	8	1713	700	1330	2.38
145	2213	9	7	2004	739	1515	2.95
160	2333	9	5	1948	749	1500	3.09
175	2029	9	3	1806	883	1740	4.36
190	2313	9	3	2134	950	1840	4.76
205	2251	9	3	2000	1040	2100	5.07
220	2400	9	3	2148	1005	2010	Broke
235	120	4.5	32	Broke	Broke	Broke	Broke

It is seen with the smoked sheet that the series commences with a "heat" quite insufficient for proper vulcanization, and continues through 15 minutes' time changes to cover the entire range, including under, good and overvulcanization, and finally in the case of the last two members of the series, reversion and degradation due to overheating after the free sulphur content has been reduced to less than 1 per cent. This is especially

[1] Read before the Rubber Division of the American Chemical Society at Philadelphia, Pennsylvania, September 5, 1919.

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appearance in the 235 minute cure which has a strength of 1,80 and an elongation of only 350 per cent or 1 to 4". Indeed, the ideal physical characteristics were to be taken as the maximum of strength, the 240-minute cure which shows the greatest tensile product, or the 305 minute which shows the greatest resistance to stretching would be selected. However, the former has a vulcanization coefficient of 4.75 and the latter of 5.07 and the author is confident that any rubber man would prefer either these pieces to be overvulcanized after making the usual commercial examination. Unfortunately insufficient time has elapsed since the original preparation of the samples to provide the results of natural weathering tests at this time. But accelerated aging tests if applied to an entire series such as this will show those members which are decidedly over or undercured and the results of physical and chemical tests made upon specimens so treated are therefore given in Table II.

TABLE II

Minutes Curing at 292° F.	Tensile Strength lbs. per sq. in.	Elongation %	Tensile Product	Load kgs. per sq. cm. at 500% Elong.	Set %	Coef. of Vulc.
120	1,611	700	1,127,700	12.5	5.0	
150	1,943	650	1,262,950	14.5	4.0	2.22
180	2,241	600	1,344,600	15.5	3.5	2.73
195	1,867	500	933,500	17.0	3.5	3.13
210			14,6	17.00	Broke	13.5
225			4.6	471	Broke	Broke
240			4.6	471	Broke	Broke
255			4.6	471	Broke	Broke
270	1,868	75	140,100	Broke	Broke	4.74
285	1,722	50	86,100	Broke	Broke	Broke
300	1,722	50	86,100	Broke	Broke	Broke
315	1,722	50	86,100	Broke	Broke	Broke
330			4.6	471	Broke	Broke
345			4.6	471	Broke	Broke
360			4.6	471	Broke	Broke

It is seen by the accelerated age test, that the sample cured 180 minutes having original vulcanization coefficient of 2.85 (Table I) is the best of the series. It will be noted that this cure yields sample having a maximum strength tensile product

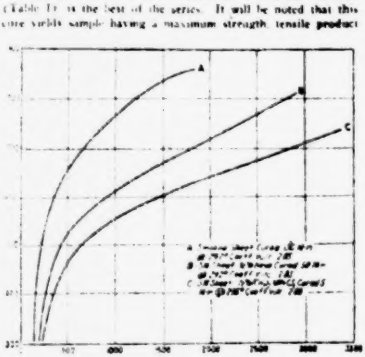

FIG. 1 STRESS-STRAIN CURVES

and the greatest resistance to stretching after the accelerated aging treatment. The selection of this as the best cured sample is well in accordance with the conclusions of Stevens in a paper read before the Society of Chemical Industry. In this it was shown that first-grade plantation rubbers vulcanized to a sulphur combination of about three stood up well during an aging period of 120 weeks, whereas those cured to a greater degree deteriorated quite rapidly. This same figure has been indicated as the proper coefficient for a mixing of the same in question by Spence, Kratz, Van Heurn and others.

Following the preparation and testing of the series mentioned, the accelerators monothiocarbanilide, diphenylguanidine, dimethyldiphenylethanamine, aldol addition product of dimethylamine and carbon bisulphide, were separately added to the original mixing, namely smoked sheet, 100 parts; sulphur 6 parts, zinc oxide 5 parts, in the proportion of 0.5 per cent to the rubber contained in the batch. The former was selected as a moderately active accelerator and the other as an example of a group which probably comprises the most active accelerators known and therefore one of the most valuable for use in illustrating the extreme possible effects of accelerators on the mechanical and chemical properties of the resulting vulcanizates. This relevance has been mentioned in the literature of rubber chemistry and should be a familiar one to our "Chemical Abstracts" January 10, 1916. The results in Table III show the effect of the aniline addition product in the mixing.

TABLE III

Minutes Curing at 292° F.	Tensile Strength lbs. per sq. in.	Elongation %	Tensile Product	Load kgs. per sq. cm. at 500% Elong.	Set %	Coef. of Vulc.
30	1,056	900	950,400	8.5	10.0	
60	1,346	900	1,211,400	11.0	12.5	1.39
90	2,000	900	1,800,000	15.5	10.0	2.07
120	2,013	850	1,711,050	17.0	7.5	2.32
150	2,240	800	1,792,000	18.5	7.5	2.58
180	2,136	750	1,602,000	19.0	7.5	2.85
210		700	1,470,000	19.5	7.5	3.04
240		650	1,365,000	20.0	7.5	3.42
270		600	1,260,000	20.5	7.5	3.80
300		550	1,155,000	21.0	7.5	4.18
330		500	1,050,000	21.5	7.5	4.56
360		450	945,000	22.0	7.5	4.94

It is apparent from these figures that the compound containing this substance not only cures in about one-third the time required for vulcanization of the untreated rubber in the same formula, but the relationship of mechanical properties to chemical composition is altogether altered. If we relate the physical properties to the vulcanization coefficient as standard, by comparing the 30-minute cure with coefficient of 2.85 with the 180-minute "correct" cure of the untreated smoked sheet at coefficient of 2.85 it is seen that the "hexa" stock has 1,044 pounds per square inch greater tensile strength, one half such its stretch, a tensile product higher by 824, and that more energy the load is required to stretch this stock to a given elongation. Making allowance for the toughening effect of the accelerator the "hexa" compound is somewhat overvulcanized at the 30-minute cure.

In Table IV are indicated the results obtained in using the dimethylamine addition product at a vulcanizing temperature of 292 degrees F.

TABLE IV

Minutes Curing at 292° F.	Tensile Strength lbs. per sq. in.	Elongation %	Tensile Product	Load kgs. per sq. cm. at 500% Elong.	Set %	Coef. of Vulc.
1	1,260	1,150	1,449,000	12.5	10.0	0.95
2	1,680	1,100	1,848,000	14.5	10.0	1.27
3	2,016	1,050	2,116,800	16.0	10.0	1.52
4	2,352	1,000	2,352,000	17.5	10.0	1.78
5	2,688	950	2,553,600	19.0	10.0	2.03
6	2,688	900	2,419,200	20.0	10.0	2.28
7	2,688	850	2,284,800	21.0	10.0	2.53
8	2,688	800	2,150,400	22.0	10.0	2.78
9	2,688	750	2,016,000	23.0	10.0	3.04
10	2,688	700	1,881,600	24.0	10.0	3.29
11	2,688	650	1,747,200	25.0	10.0	3.54
12	2,688	600	1,612,800	26.0	10.0	3.79
13	2,688	550	1,478,400	27.0	10.0	4.04
14	2,688	500	1,344,000	28.0	10.0	4.29
15	2,688	450	1,209,600	29.0	10.0	4.54

In this instance it is seen that samples having satisfactory physical properties were obtained in vulcanizing periods of three, four and five minutes with the abnormally low coefficients of 1.09, 1.21 and 1.45, respectively. The same mixture was also vulcanized at 295 degrees F., the results being given in Table V.

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TABLE V

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note: The greater degree of cure of this series as compared to that used in Table IV depends on factors introduced by the slight increase in temperature. It is probable that the raw stock was heated to a greater extent in the course of mixing.

In this series, the sample cured one minutes coefficient *2.00* closely approaches the *2.05* coefficient of the corresponding cured sample sheeted short. Comparing the physical characteristics of these two, we find a difference of 1,584 pounds tensile strength in favor of the accelerated stock, a loss of 1.2 inches in elongation at the breaking point, a tensile product higher by 927, and an even greater resistance to stretching than in the case of the rubber containing hexamethylene tetramine. This sample is undoubtedly much overvulcanized.

Figure 1 shows the stress-strain curves of the three samples, all taken from the same lot of rubber and all cured to vulcanization coefficients of 2.00 to 2.05 by means of vulcanizing periods ranging from five minutes to two hours and ten minutes. It affords a graphic illustration of the variation in physical properties referred to essentially the same vulcanization coefficient.

Figure 2, on the other hand, illustrates the range of the vulcanization coefficients for the same samples, referred to the load required to produce a uniform elongation of 700 per cent. By reference to these curves, we find that about 4.9 per cent of combined sulphur is necessary to produce a sample of unaged rubber requiring a load of 1,000 pounds to stretch it through 700 per cent. In the case of the same rubber containing in addition of ½ of one per cent of "hexa," the same effect was produced when about 1.8 per cent of sulphur has been combined. With the introduction of the dimethylamine addition product, the corresponding coefficient drops to 0.9 per cent. Figure 2 also exhibits a curve representing the compound reported in Table VI which consists of the basic formula and 1 per cent of the dimethylammonium-dimethyl-dithiocarbamate.

TABLE VI

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Sample cut with the grain
Sample cut across the grain
Sample cut with the grain
Sample cut across the grain

Three samples were not heated at all, being mixed, calendered and stored in the dark between sheets of holland cloth. The tests shown were made one month and two months after preparation, and certainly show that spontaneous vulcanization has taken place to a very considerable extent. With this mixing we find, since to a very considerable extent. With this unheated material would require the load of 1,000 pounds to stretch it to 700 per cent when only 0.7 per cent of sulphur has entered into combination with the rubber. The general tendency is for the curves to flatten toward the load axis as the period of heating is reduced, and this gives some indication of the extent to which rubber is depolymerized by heat and shows that extremely low sulphur combination is sufficient to vulcanize when the period of heating is reduced to a minimum or entirely omitted. The turn of the curve representing the unheated rubber in the neighborhood of the 5 per cent combined sulphur line again illustrated the reversion which takes place when heating is continued after the bulk of the sulphur has entered into combination. The turn at the 3 per cent point in the case of the "hexa" sample is indicative of the great care necessary when

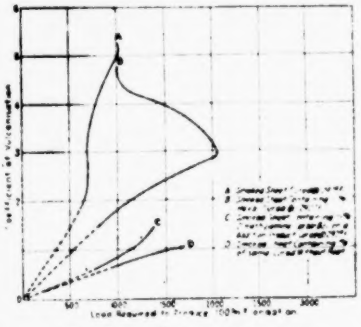

FIG 2. RANGE OF VULCANIZATION COEFFICIENT

using this substance, since if the sulphur in the compound is held down to a figure which is not low, results equally as disastrous as those coming from overcure will inevitably follow the overheating of such compounds.

Work along very similar lines was also carried out with an inferior type of brown plantation crepe, the results of which are indicated in Tables VII and VIII.

TABLE VII

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE VIII

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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In this case, the figures reported are limited to the tests made on the straight rubber and the same rubber to which was added ½ of 1 per cent of the dimethylamine-carbon bisulphide addition product. Preliminary tests on this rubber treated with hexamethylene tetramine showed that satisfactory vulcanization could only be obtained with the addition of higher proportions of zinc oxide. Figure 3 shows the complete stress-strain curves

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of 120, 180, 240 and 300-minute cures at 292 degrees F on the rubber with 6 per cent sulphur and 1 per cent zinc oxide, these being represented by the dotted line curves A, B, C and D, respectively. On the same graph there is also indicated the stress-strain curves corresponding to 1, 2, 3, 4 and 5-minute cures at 292 degrees F, in case of the same mixing containing a ½ of one per cent addition to the powerful catalyst, these being the solid lines E, F, G, H, J and K, respectively. Addition of ½ and ¼ of 1 per cent were not sufficient to produce good vulcanization at a temperature of 292 degrees in periods ranging from 2 to 5 minutes. These results are in general similar to those obtained by adding the accelerator to the smoked sheet, but are more notable, inasmuch as the brown crêpe was altogether incapable of being well vulcanized in its natural state, whereas through the use of the accelerator, samples having good physical properties are produced in extremely short vulcanizing periods.

It is to be noticed that the sample in Table VI cured 240 minutes and represented by Curve C in Figure 3, has all the characteristics of a technically undercured sample, although the coefficient amounts to 3.45, which is well above the 3 per cent limit mentioned for first-grade rubbers. On the other hand, the sample cured for 300 minutes is undoubtedly both overcured and overheated. The best cure would, therefore, fall between these points, but it is evident that no good cure is possible with this rubber except through treatment with chemical accelerating agents.

Although more results would be required before any definite conclusions should be drawn, the writer would summarize as follows:

SUMMARY.

(1) Although average good quality plantation *Hevea* rubbers may require a combination of sulphur of about 3 per cent to effect the proper or optimum cure, such rubbers can be vulcanized in a small fraction of the original time through the use of very powerful catalysts, together with zinc oxide, in which case excellent physical properties are obtained in samples, the vulcanization coefficient of which may be in the neighborhood of one.

(2) Inferior types of plantation rubbers which are incapable of being transformed into satisfactory vulcanizates through the

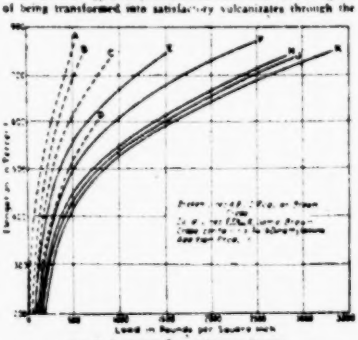


Fig. 3. Complete Stress-Strain Curves.

agency of sulphur alone may be readily vulcanized in very short curing periods and at normal vulcanizing temperatures through the use of powerful accelerators in the presence of small quantities of oxide of zinc. Although such rubbers may be undervulcanized when as much as 3½ per cent of sulphur is brought into combination through prolonged heating, good mechanical properties may be found in samples having abnormally low vulcanization coefficients when the vulcanization is carried out with maximum heating through the use of powerful accelerators.

(3) No definite figure can be established for the vulcanization coefficient of properly vulcanized soft rubber goods in general, or for the optimum cure of any mixing in particular, for the reason that the mechanical properties, as well as the chemical combination of sulphur is influenced by the time and degree of temperature used for vulcanizing.

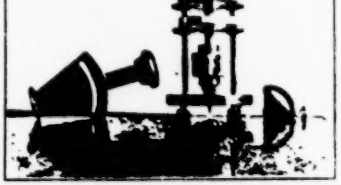
(4) It would appear probable, however, that in the case of any definite compound, the vulcanizing conditions could be standardized by the use of an accelerator and that the degree of vulcanization could then be checked most accurately through determinations of the coefficient of vulcanization.

SOME METHODS OF TESTING THE HARDNESS OF VULCANIZED RUBBER.

By H. P. Gurney.

USUAL QUALITATIVE METHODS.

The most natural way for an experienced rubber man to estimate the hardness of a piece of cured rubber is to note the force required to indent it with the point of a pencil or similarly convenient means. Although practical rubber workers are thus able to distinguish very accurately between different grades



Durometer. Plastometer. Durometer.

of rubber coverings, the information acquired is of no value as a matter of record since it cannot be designated quantitatively.

QUANTITATIVE METHODS.

Spring Type Apparatus. The use of any of these different instruments for obtaining a figure expressing the hardness of rubber surfaces affords an accurate method for the comparison and recording of the quality of hardness by an arbitrarily chosen number.

In instruments of the spring type, the force is applied by means of a spring and the rubber is indented by a point of specified shape and dimensions.

The Durometer is an extremely convenient pocket instrument of this class. On its scale the hardness of glass or steel registers 100, while that of soft rubber good may register as low as 40.

At the Boston Belting Corp.'s factory, a so-called "Durometer" has been in use for many years. This instrument is also of the spring type. A perfectly hard object has a durometer reading of 1000, while softer objects may run as low as 250. There is one marked disadvantage in the use of the spring type of hard-

[1] Read before the Rubber Division of the American Chemical Society, at the Philadelphia meeting, September 24, 1919.

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G. D. KRATZ.

TIRE AND METHOD OF MAKING SAME.

APPLICATION FILED MAY 26, 1919.

1,428,040. **Patented Sept. 5, 1922.**

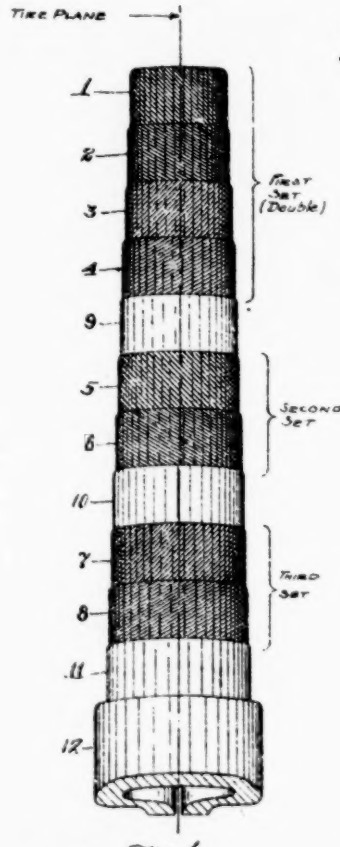

Fig. 1.

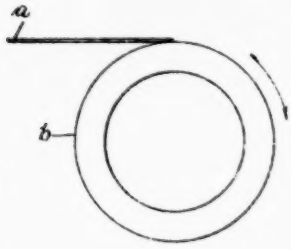

Fig. 3.

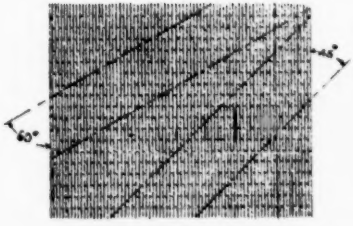

Fig. 2.

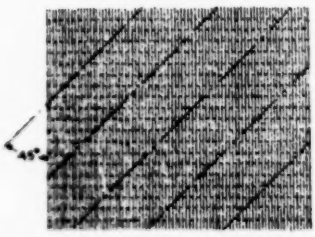

Fig. 4.

Fig. 5.

Fig. 6.

INVENTOR
George D. Kratz
By Jay Oberlin & Jay.
ATTORNEYS

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Patented Sept. 5, 1922. 1,428,040

UNITED STATES PATENT OFFICE.

GEORGE D. KRATZ, OF AKRON, OHIO, ASSIGNOR TO THE FALLS RUBBER COMPANY, OF CUYAHOGA FALLS, OHIO, A CORPORATION OF OHIO.

TIRE AND METHOD OF MAKING SAME.

Application filed May 26, 1919. Serial No. 299,575.

To all whom it may concern:

Be it known that I, GEORGE D. KRATZ, a citizen of the United States, and a resident of Akron, county of Summit, and State of Ohio, have invented a new and useful Improvement in Tires and Methods of Making Same, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The present improvements, relating, as indicated, to tires and methods of making same, have more particular regard to tire-shoes or casings, such as are largely used for motor-driven vehicles. More particularly still, such improvements relate to that type of tire-shoe which is constructed of so-called thread-fabric or cord fabric, i. e., of a fabric composed of strong longitudinal warp threads held together by fine non-strength-giving weft threads. In fact, in some cases such warp threads are held together simply by the film or coating of rubber which is ordinarily used as a cementing or binding material to hold the several layers of the tire together. In the present specification it will accordingly be understood that by the term "warp threads" such longitudinal strength-giving threads are referred to, irrespective of how they are held together.

Tires of the type in question have, so far as I am aware, been heretofore constructed in either one or the other of two ways. According to the first method of manufacture the layers of fabric, suitably rubber coated, as previously indicated, are applied one upon the other in such a manner that the warp threads of each layer of fabric are at right angles to the warp threads of each contiguous layer of fabric, whether above or below it. For example, in a six-ply thread fabric tire-shoe, constructed in accordance with this first method, the first, third and fifth layers of such fabric will have their threads parallel with each other and at an angle of 45 degrees to the plane of the tire, while the second, fourth and sixth layers will have their warp threads parallel with each other and at an angle of 45 degrees to the plane of the tire, but at right angles to the warp threads of the first-mentioned layers. The objection to this construction is that when the warp threads of contiguous layers or plies of fabric are thus at right angles to each other, even though they be separated by a rubber cushion, excessive friction occurs due to chafing between the crossed strands, and the heat generated by such friction is sufficient to materially weaken the tire carcass and to decrease the life of the same. A second method of construction of the type of tire in hand has consisted in applying a set of two, three or more contiguous layers of thread fabric with their respective warp threads parallel with each other and at an angle to the tire plane, and superimposing thereon another set of two, three or more layers of such fabric with their respective warp threads likewise parallel with each other, but disposed at an angle to the warp threads of the first set. By this construction the number of contacting or rubbing surfaces has been reduced, and it has also been considered that such construction can be more readily repaired than the first described construction, inasmuch as two plies of thread fabric can be removed together, thus permitting the introduction of new plies to replace them, which is next to impossible where such plies lie at right angles to each other.

Despite the foregoing points of superiority over the first described construction such second construction has nevertheless been found not entirely satisfactory. In the first place, the initial strength of a tire carcass constructed according to such second method is less than that of a similar carcass constructed according to the first method. In the second place, when a tire of such second construction is inflated the strands or threads in each layer are separated, i. e., the distance between individual strands in each layer is increased, owing to the fact that such layer is distended to cover a larger area, according to the pressure to which the tire is inflated, and to the extent to which pressure causes the carcass to distend. Accordingly, as the parallel strands in two contiguous layers are thus forced apart, there is a tendency for such strands in the one layer to fall into the interstices of the other, with the result that the effect of but a single layer of fabric is secured. Accordingly, in practice, this second construction amounts to but little more than the first, the several parallel layers of each group

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becoming, in effect, a single layer which is disposed at right angles to the parallel layers of the other group. The object of the present invention is to overcome the objections just noted as existing in connection with each of the two methods heretofore devised for the construction of fabric tires of the type in hand.

To the accomplishment of this object I apply the various layers of rubber-coated thread fabric in sets composed of two, three or more layers so cut or disposed that the strands of no two contiguous layers are either parallel or at right angles to each other. I accomplish this result, either by the use of plies of fabric which are cut on the bias, but at two or more different angles to the strands themselves, or by cutting all such plies on the bias at the same angle and subsequently distorting the individual plies as they are fixed in place in the carcass, so that their relative angles will be different. The invention, then, consists of the steps and means hereinafter fully described and particularly pointed out in the claims, the annexed drawing illustrating but one of several ways in which the principle of the invention may be utilized or embodied.

In such annexed drawing, Fig. 1 is a plan view of a section of a tire, shown for convenience as a straight, instead of a curved section, and with successive portions broken away, better to illustrate the interior construction thereof; Fig. 2 is a plan view showing a sheet of the thread fabric and the manner in which successive strips or plies are cut therefrom in order to construct the tire in accordance with the present invention; Fig. 3 is a side elevation, more or less diagrammatic in character, illustrating the manner in which such plies or layers of fabric are secured to the carcass; Fig. 4 is a view similar to Fig. 2, but shows another method of cutting the strips or plies from the sheet of fabric; Fig. 5 is a view of such a strip or ply; and Fig. 6 is a view of the same strip as in Fig. 5, but after it has been distorted or stretched to give the effect of the cutting of the same on a different angle from the original sheet.

In the illustrative construction of tire shown in Fig. 1, an eight-ply tire, or rather tire-shoe, is shown, the plies or layers of fabric being arranged in three sets, each made up of a plurality of contiguous layers or plies of thread fabric. The innermost of these sets, as shown at the upper end of the figure in question, is really a double set, being composed of four layers or plies, 1, 2, 3 and 4, the first such layer or ply being cut so that the strands therein lie at an angle of 45 degrees to the plane of the tire, and such layer being applied so that such strands run to the right of such plane; (that is, such strands lie at the angle and run in the direction stated with respect to a median circumferential line passing around the periphery of the tire, assuming such strip to be regarded from the outside of the tire and as being disposed in tangential relation thereto), the second layer or ply being cut at an angle of 30 degrees to the tire plane, and being applied so as to have the strands run to the right of such plane; the third layer or ply being cut at an angle of 45 degrees to the tire plane and being applied to have the strands run to the left of such plane; and the fourth layer or ply being cut at an angle of 30 degrees to the tire plane and being applied so as to have the strands run to the left of such plane. The relation of the various layers or threads in the layers comprising such set may be also described by stating that such layers or threads are at a slight angle to each other and diverge from each other at a median line at or parallel to the periphery of the tire, both threads lying in the quadrant formed by such a median line and a line at right angles to it passing through the point of intersection of said thread. The second set of contiguous layers of fabric comprises two such layers 5 and 6, the first of which is cut at an angle of 45 degrees to the tire plane and applied so as to have the strands run to the right of such plane, and the second of which is cut at an angle of 30 degrees and applied so as to have the strands run in the same direction as the first. The third set of contiguous layers of fabrics also comprises but two such layers 7 and 8, the first of which is cut at an angle of 45 degrees to the tire plane, but is then applied so as to have the strands run to the left of such plane, the second layer being cut at an angle of 30 degrees to the tire plane and applied so as to have the strands run in the same direction.

In between each successive set of such layers or plies of fabric there are preferably interposed layers 9 and 10 of rubber, respectively, which function in an insulating and cushioning capacity, but these rubber cushions are not essential. The outermost or last-mentioned set of layers of fabric is then covered by the usual breaker strip 11, which is composed of a heavy gum cushion of suitably prepared rubber calendered upon an open-weave fabric. Finally the whole is covered with an outer layer 12 of rubber constituting the tread of the tire.

Where the several strips, composing the successive sets of layers or plies of fabric, are initially cut from the original sheet of fabric upon the bias so that the strands therein will have the relative angularities described above, (see Fig. 2), the process of building my improved tire from these separate layers of fabric, rubber cushions and tread upon a solid or collapsible form

or core and then vulcanizing it, will be precisely the same as the method in current use in building tires, and need not, therefore, be further described. In Fig. 3 I illustrate diagrammatically the manner in which a strip *a* of fabric is applied to the core or carcass *b*, the arrow indicating the direction in which the core is intended to be rotated.

However, instead of thus initially cutting the several strips or layers of fabric in question so that the strands will lie at the desired angle, this involving a certain element of wastage, as will be indicated by an inspection of Fig. 2, I preferably cut these strips all in the same angle, thus reducing wastage to a minimum. Assuming the angle chosen to be 45 degrees, the typical strip *c* will then present the appearance illustrated in Fig. 5, which strip will obviously serve, without change, for half of the total number of strips required in the construction of the tire as just described, inasmuch as by simply reversing the strip, the strands *d* may be caused to run either to the right or left of the plane of the tire, as desired. In order to secure a different degree of angularity for the strands in the strip as applied from that to which the strip is thus initially cut, I then proceed as follows:— The strip cut as aforesaid, as later applied to the core or partially assembled carcass, is attached along its median line *e* only in the first instance. Then by pulling in opposite directions on the respective lateral edges of the strip, one such edge is applied in advance, and the other to the rear of its normal position, thus increasing or decreasing the angularity at which the strands lie to the plane of the tire. I have found it entirely feasible to change such angularity in this fashion from 45 degrees to 30 degrees, as illustrated in Fig. 6, for example, or reversely from 30 degrees to 45 degrees, and if preferred the strip may be distorted before it is applied.

Whichever method of construction is employed, it will be obvious that by arranging the superimposed layers or plies of fabric which compose the successive sets of such fabric, so that, while slightly divergent, the warp threads of said layers nevertheless run in the same direction (i. e., any two intersecting threads lie on the same side of a transverse line drawn through their points of intersection), I reduce the detrimental effects caused by the parallelism of strands in contiguous plies, and at the same time retain the greater portion of the initial strength obtained by crossing alternate and contiguous plies at right angles to each other. In other words, my method of superimposing plies of fabric, which have either been cut on the bias at two or more slightly divergent angles to the strands or threads, or else distorted or stretched to give the same effect, combines the advantages sought for in both of the two methods heretofore utilized, while at the same time I reduce the detrimental feature of chafing between the plies and its attending friction, which results in weakening the tire carcass. Finally, it will be seen that while my improved construction retains the carcass strength previously obtained by the first described prevailing construction, the added resiliency obtained by the second such construction has not been sacrificed.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the steps or mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. A component for a tire of the character described, comprising a set of superposed contiguous layers of thread fabric having their respective warp-threads lying at a slightly divergent angle to each other, but extending in the same general direction relative to a median line around the periphery of the tire, i. e. any two intersecting threads lie in the same quadrant formed by a transverse line and a line parallel with said median line passing through the point of intersection of said threads.

2. A tire of the character described, comprising a set of superposed contiguous layers of thread fabric having their respective warp-threads lying at a slightly divergent angle to each other but extending in the same general direction to the tire plane, i. e. any two intersecting threads lie in the same quadrant formed by a transverse line and a line parallel with said median line passing through the point of intersection of said threads, and another set of similar layers having their respective warp-threads also lying at a slightly divergent angle to each other, the warp-threads of said second set of layers similarly extending in the same general direction relatively to the tire plane but at an angle to the warp-threads of the first set of layers.

3. A tire of the character described, comprising a set of superposed contiguous layers of thread fabric having their respective warp-threads lying at a slightly divergent angle to each other but running in the same general direction relatively to the tire-plane, i. e. any two intersecting threads lie on the same side of a transverse line through their point of intersection, and another set of similar layers having their respective warp-threads also lying at a slightly divergent angle to each other, the warp-threads of said second set of layers similarly running in the same general direction

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relatively to the tire-plane but at an angle to the warp-threads of the first set of layers less than a right angle.

4. A tire of the character described, comprising a set of superposed contiguous layers of thread fabric having their respective warp-threads lying at a slightly divergent angle to each other, but running in the same general direction relatively to the tire-plane, i. e. any two intersecting threads lie in the same quadrant formed by a transverse line and a line parallel with a median line around the periphery of the tire passing through the point of intersection of such threads, another set of similar layers having their respective warp-threads also lying at a slightly divergent angle to each other, the warp-threads of such second set of layers similarly running in the same general direction relatively to the tire-plane but at an angle to the warp-threads of the first set of layers, and a layer of rubber forming a cushion between said two sets of fabric layers.

5. In a method of making tires of the character described, the steps which consist in applying circumferentially to a suitable mandrel a strip of fabric cut on the bias first along the median line of such strip and then retarding one edge only of such strip so as to modify the angularity of the component warp-threads therein relatively to the plane of such mandrel before fully applying such strip.

6. In a method of making tires of the character described, the steps which consist in applying circumferentially to a suitable mandrel a strip of fabric cut on the bias first along the median line of such strip and then pulling on the respective edges of said strip in opposite directions so as to modify the angularity of the component warp-threads therein relatively to the plane of such mandrel before fully applying such strip.

7. In a method of making tires of the character described, the steps which consist in applying circumferentially to a suitable mandrel successive strips of fabric on the bias, and distorting or stretching alternate such strips incidentally to application so as to vary the angularity of the component warp-threads from normal relatively to the plane of such mandrel.

Signed by me, this 23rd day of May, 1919.

GEORGE D. KRATZ.

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THE
RUBBER AGE

FEBRUARY 25, 1929

The Action of Certain Organic Accelerators in the Vulcanization of Rubber—III

By G. D. Kratz, A. H. Flower and B. J. Shapiro

Falls Rubber Co., Cuyahoga Falls, Ohio

[illegible] that although aniline is effective as an accelerator in the absence of zinc oxide diphenylthiourea functions but feebly in the absence of, and strongly in the presence of, this substance. It remains to be added that [illegible] has been made indirectly in the literature quoted above and recently. These data have given curves for physical test results which demonstrate quite clearly the effectiveness of diphenylthiourea as an accelerator in the presence of zinc oxide. The statement that diphenylthiourea is practically inert in the absence of zinc oxide is, however, not in accord with our findings.

In a previous paper of this series we have shown that in the vulcanization of rubber with sulphur mixtures, [illegible] a definite part of diphenylthiourea is broken down into its constituent aromatic amine, but equal to that of one molecular part of aniline and one molecular part of [illegible] and

[illegible] which, however, were confined to the determination of the [illegible] at one rate only. In the present [illegible] we desired to compare the relative effects of [illegible] and diphenylthiourea over a series of cures, and to [illegible] the sulphur coefficients for the [illegible] mixtures and cures. Further it was desired to compare mixtures which contained [illegible] in addition to the rubber-sulphur mixture previously [illegible]

In the experimental part of this paper we have given results [illegible] for different cures, as follows: a rubber [illegible] which contained zinc oxide, and [illegible] which contained either one molecular part of [illegible] diphenylthiourea. All of the mixtures were vulcanized [illegible] at 274° F. [illegible] cures over a wide range of time. After [illegible] measurements of sulphur coefficients and physical properties were made.

Summary of Results

[illegible] may now results briefly, we found that, in a rubber-sulphur mixture the accelerating effect of aniline is considerably greater than that of diphenylthiourea, when judged [illegible] by sulphur coefficients or on the basis of the physical

[illegible] of the Rubber Division of the [illegible] Meeting of the [illegible] Society, Chicago, Ill., September 4 to 7, 1928; [illegible] of Rubber and Engineering Chemistry.

[illegible]

[illegible] Rubber Age (New York), 23 [illegible]

[illegible] Rubber Chem. & Technol., 1 [illegible]

[illegible] Rubber Chem. & Technol., 1 [illegible]

[illegible] Rubber Chem. & Technol., 1

When aniline is replaced by diphenylthiourea the reverse is true, and the activity of the original substance as an accelerator is greatly increased when measured by either the sulphur coefficients or physical properties. In the latter instances, then, the zinc oxide most probably either assists in the decomposition of the diphenylthiourea to a more active substance, or combines with the decomposition or alteration products or the original substance with the formation of a zinc salt, which is responsible

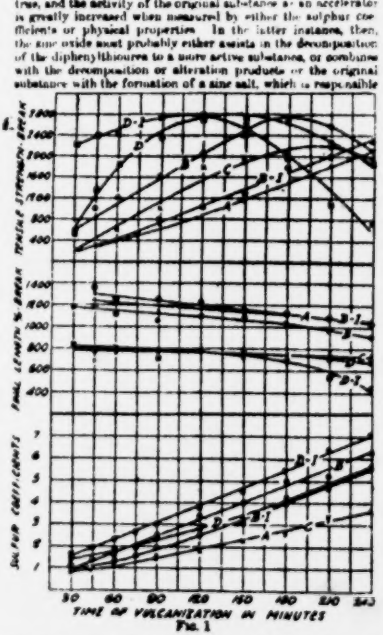

FIG. 1

for the increase both in the sulphur coefficients and tensile strength of the mixture. Our results with aniline as the accelerator, however, do not indicate the formation of such a salt.

Thus, in the presence of zinc oxide, the activity of aniline and diphenylthiourea as accelerators appears to be of different nature. Evidently, an acid substance, probably a thiocarbamic acid, capable of reacting with zinc oxide, is formed as one of the decomposition products of diphenylthiourea. The excess accelerating activity is attributed to this zinc salt. When aniline is employed as the accelerator, there is no evidence of such salt formation.

The present experiments were designed to effect a comparison of the sulphur coefficients and physical properties of representative mixtures when accelerated by 0.01 gram-molecular quantities of either aniline or diphenylthiourea. The six following mixtures were employed for this purpose, and each was vulcanized for a series of cures:

A—Rubber-sulphur control
B—Rubber, sulphur, and aniline
B-1—Rubber, sulphur, and diphenylthiourea
C—Rubber, sulphur, and zinc oxide control
D—Rubber, sulphur, zinc oxide, and aniline
D-1—Rubber, sulphur, zinc oxide, and diphenylthiourea

[1] Jour. Ind. & Eng. Chem., 12 (1920), 31.
[2] India Rubber World, 61 (1920), 356.
[3] In the experiments described in Parts I and II vulcanization was carried on at a temperature of 140° C.
[4] Satisfactory physical test results for compounding proportions obtainable with considerable difficulty. We found it necessary, particularly when making results for stress-strain diagrams, to employ three sets, one to operate the machine and two to take readings.
[5] As W. Noble has stated ("Precision Rubber and the Testing of Rubber," 1920, 206, Longmans, New York), complete stress-strain diagrams are probably required for an accurate determination of this point.

The quantities of each substance employed in these mixtures are shown in Table I. The amounts of aniline or diphenylthiourea added in these respective mixtures represent 0.01 gram-molecule of the accelerator per each 100 g. of rubber in the mixture. Otherwise, the same general method of procedure was adopted in the course of this work as in that previously reported in Part I.

The rubber used was of good quality, first latex, pale crepe, a different sample of the lot used in our former experiments. The various mixtures were mixed on the mill, vulcanized, and tested in the same manner as before. The physical properties of the vulcanized samples were determined on a Scott testing machine of the vertical type, with the jaws opening at the

TABLE I

Ingredient	Mix-ture A	Mix-ture B	Mix-ture C	Mix-ture D	Mix-ture B-1	Mix-ture D-1
Rubber	100.00	100.00	100.00	100.00	100.00	100.00
Zinc oxide			100.00	100.00		100.00
Sulphur	8.1	8.1	8.1	8.1	8.1	8.1
Aniline		0.93		0.93		
Diphenylthiourea					3.56	3.56

rate of 20 inches per minute. A recovery period of 48 hours was allowed before physical tests were made. Combined sulphur was estimated by our method previously reported in detail.[5]

The various mixtures were vulcanized at 141.8°C for different intervals of time up to 240 minutes.[4] The sulphur coefficients and physical properties of the different cures for each mixture were determined. These results are given in detail in Table II and shown graphically in Fig. 1. Generally speaking, the results obtained were in good agreement, and fairly smooth curves for physical properties were obtained.[4]

For brevity and clearness, the results obtained for each mixture have been considered separately.

The Results Obtained

MIXTURE A.—This mixture of rubber and sulphur served as a control only.

MIXTURE B—Comparing Curves A and B, aniline not only acts as an accelerator, but also slightly increases the physical properties of a rubber-sulphur mixture after vulcanization.

MIXTURE C—The inclusion of zinc oxide in Mixture C was found to have little or no effect upon the sulphur coefficients when compared with the results obtained for A.

MIXTURE D—The sulphur coefficients obtained for this mixture were found to be uniformly lower than the corresponding cures of B. Moreover, the maximum tensile strength of D was attained at a much lower sulphur coefficient than in the case of B, although this maximum tensile strength was almost the same in both instances.

MIXTURE B-1—From the curves it is seen that in a mixture of rubber and sulphur the activity of diphenylthiourea is much less than that of aniline, when judged by either sulphur coefficients or physical properties. In fact, both the tensile strengths and final lengths of B-1 are practically the same as those of its control mixture, A. The sulphur coefficients of B-1, however, were decidedly higher than those of A, and, contrary to the statement of Twiss, we cannot regard diphenylthiourea as practically inert as an accelerator in a mixture of rubber and sulphur only.

MIXTURE D-1—The sulphur coefficients for D-1 were considerably higher than those of any of the other mixtures; although the maximum tensile strength was of the same magnitude, it was reached in shorter time.

Comparison of Lengths

The curves showing the comparison of the final lengths are given in Fig. 1. It is obvious that the physical manifestations, especially in Mixtures D and D-1, are found in the tensile strength, rather than in the final lengths, of the vulcanized mixtures. Consequently, the tensile strengths of such mixtures, particularly until maximum tensile strength was reached, are better indications of the point known as the "optimum cure" than are the loads required to effect a given extension.[5]

The effect of the two accelerators, aniline and diphenylthiourea, have been summarized in Fig. 2, wherein with Mix

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Table II

All Mixtures Vulcanized at 141.5° C.

Time in Minutes	Mixture A			Mixture B			Mixture C			Mixture D			Mixture D-1			Mixture D-2		
	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent	Sulphur Coefficient	Tensile Strength, Lbs. per Sq. In. at Break	Final Length at Break Per cent
30	0.792			1.156	565	1140	1.005			1.484	560	710	0.833	375	1310	1.469	2310	920
45	0.858	278	1250	1.317	1010	1170	1.005	198	800	1.480	1380	770	1.063	475	1300	1.913	3201	780
60	1.018			1.583	1224	1130	1.207	362	750	1.459	1919	770	1.335	475	1300	2.207	3448	780
75	1.097	398	1220	1.686							1984	750	1.469	532	1280	2.423		
90	1.231	506	1180	2.002	1921	1140	1.558	1042	780	2.302	2302	750	1.868	799	1260	2.968	3720	790
135	2.108	972	1180	2.351	2046	1140	1.795	1615	760	2.401	2404	750	2.494	1055	1210	3.785	3889	770
150	2.726	1150	1130	2.733	2411	1140	2.317	1910	760	2.598	2521	770	3.100	1205	1150	4.531	3919	750
180	2.470	1751	1130	4.930	2972	1110	2.820	2193	740	4.229	2663	740	4.097	1779	1110	5.357	3793	690
210	3.179	1962	1100	5.274	3346	970	3.481	2146	740	4.666	2743	740	4.750	2021	1060	6.179	3118	530
240	3.751	2126	1060	6.244	2191	610	3.912	1976	720	5.194	1937	660	5.094	2163	1050	7.079	754	440

Test pieces 4.5 mm thick

tures A and C as controls, the excess sulphur coefficients were plotted against their times of vulcanization. A comparison of the curves for B and D show that, when judged by sulphur coefficients only, the activity of aniline as an accelerator is increased in the absence of zinc oxide. (3). On the other hand, a comparison of B-1 and D-1 shows that diphenylthiourea is approximately twice as active in the presence of zinc oxide than when this substance is absent from the mixture. In fact, the difference between curves B-1 and D-1 is so great that our results indicate the formation of a more and more active accelerator than the original diphenylthiourea, or its decomposition products. It is not permissible that the decomposition products of diphenylthiourea react with the zinc oxide in the presence of sulphur to form varying amounts of a zinc salt of a dithiocarbamic acid. Salts of the latter type have already been mentioned as violent accelerators. On the other hand, the fact that the curve for Mixture D, which contains aniline and zinc oxide, falls below that of B, which contains aniline but no zinc oxide, argues against the formation of diphenylthiourea and the subsequent formation of the zinc salt of its decomposition or conversion products from the aniline originally present in the mixture.

The preceding observations are probably applicable to mixtures of the same general type and composition as employed in the course of this work only.

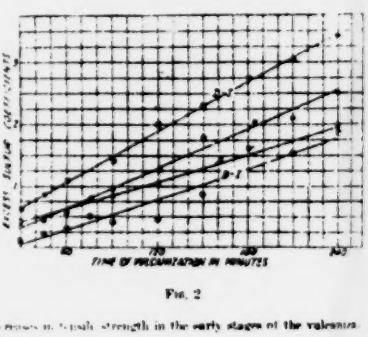

FIG. 2

Conclusions

(1). In a rubber sulphur mixture, the activity of aniline in the acceleration of vulcanization is much greater than that of a molecularly equivalent quantity of diphenylthiourea.

(2). In mixtures which contain zinc oxide, diphenylthiourea is more active than aniline.

(3). In mixtures accelerated by aniline, either with or without zinc oxide, the same maximum tensile strength is obtained.

The sulphur coefficients and physical properties of Mixture D are not concordant, but those of any of its other mixtures.

(4). Mixtures which contain zinc oxide, and which are accelerated by either aniline or diphenylthiourea, show large increases in tensile strength in the early stages of the vulcanization.

5. Mixtures which contain zinc oxide and which are accelerated by either aniline or diphenylthiourea, attain the same maximum tensile strength at approximately the same sulphur coefficients.

6. There is apparently no general relation between the physical properties and sulphur coefficients of accelerated mixtures.

Rubber Exports from Java

The exportation of plantation rubber from Java and Madoera amounted to 17,211 tons in 1918, as against 18,843 and 13,944 tons in 1917 and 1916, respectively. In 1918 Singapore imported 7,551 tons, as against 1,728 in 1917 and 2,077 in 1916. The United States, formerly the chief buyer, took but 5,844 tons in 1918, as against 14,840 tons in 1917 and 9,217 tons in 1916. From the outlying possessions the United States imported 7,640 tons in 1918, about one-half of the amount for 1917, which was 14,895 tons. Great Britain's trade likewise fell from 3,848 tons in 1917 to 1,895 tons in 1918. Singapore imports rose abruptly from 7,059 tons in 1917 to 16,485 tons in 1918. Considerable shipments were sent to Singapore, where the rubber was warehoused, awaiting a favorable opportunity for realization. The signing of the armistice restored favorable prices. 1 florin (40.482) per ½ kilo for prime qualities and 0.87½ florin (40.352) per ½ kilo for parcels containing 75 per cent of these qualities.

On November 15, 1918, the Rubber Producers' Union was formed at Batavia in order that united action might in the future be possible in marketing the colonial rubber.

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THE USE OF DIPHENYLGUANIDINE AS AN ACCELERATOR OF VULCANISATION.

By W. M. AMES, M.A., B.Sc.

Diphenylguanidine appears to be used to a very considerable extent by rubber manufacturers as an accelerator of vulcanisation, and a study of its properties as such may therefore be of value. There is now a large volume of literature dealing with the numerous organic accelerators, but practically all of it is concerned with the mechanism of the phenomenon of acceleration, and there is little information to assist the manufacturer in the actual use of these materials. In this respect diphenylguanidine, or, as it will be hereafter denoted for the sake of brevity, D.P.G., is no exception.

Kratz, Flower, and Coolidge (J. Ind. Eng. Chem., 1920, 12, 317) attempted to correlate chemical structure and accelerating effect for a number of substances, of which D.P.G. was one. They further gave data which showed it to be a very active material. Winfield Scott (India Rubber J., 1922, 64, 605) investigated some of its reactions, and (Ind. Eng. Chem., 1923, 15, 286) compared it with other guanidines in its behaviour towards sulphur. Regarding its technical use, Weber stated (India Rubber J., 1922, 63, 795) that it did not produce any discoloration in the finished article, that it could be incorporated without danger of premature vulcanisation in the mixing machine, and that quantities up to ½% on the rubber could be used with safety. It has been further stated (Le Caoutchouc et la Gutta Percha, 1923, 11816) that the most satisfactory quantity of sulphur to use along with it is from 3% to 5%, and that it produces very flat curing mixings. This rapid survey of the available literature on the subject indicates that the technical use of D.P.G. has perhaps not received the attention which has been given to such well-known organic accelerators as *p*-nitrosodimethylaniline, thiocarbanilide, and hexamethylenetetramine. In order to show how it compares in activity with some of the earlier discovered accelerators, the first portion of this paper is devoted to a comparison between D.P.G. and *p*-nitrosodimethylaniline, or "accelerene," as it is generally, for convenience, called.

This comparison was carried out first by vulcanising straight test pieces until they reached a standard elongation under a standard load, as indicated in an earlier paper (Anderson and Ames, J., 1923, 136T). Small equal quantities of D.P.G. and accelerene were incorporated into a control containing rubber and sulphur in the ratio 90:10. Another control containing, in addition, 5% of zinc oxide, had also small quantities of the accelerators added to it. In order to make the quantities of accelerator the same, allowance had to be made for the presence of 33% of water in the accelerene. The six mixings were thus made up as follows, figures denoting parts by weight:—(1) Control: Plantation sheet 90, sulphur 10. (2) Control 98, D.P.G. 2. (3) Control 98, accelerene 3. (4) Zinc oxide control: Plantation sheet 45, sulphur 5, zinc oxide 50. (5) Control (ZnO) 100, D.P.G. 1. (6) Control (ZnO) 100, accelerene 1½. The length of time at a temperature of 142° C. necessary to vulcanise test pieces made up with these mixings, so that they reached a standard elongation under a standard load, is shown in Table I. The acceleration is calculated as a percentage of the time of vulcanisation of the appropriate control.

TABLE I.

Mixing.	Time of vulcanisation at 142° C. (287° F.)	Acceleration %.
1	3 hr.	—
2	30 min.	89
3	15 „	92
4	2 hr.	—
5	15 min.	87
6	17 „	88

D.P.G. is seen to be an accelerator of practically the same power as accelerene. The presence of zinc oxide does not appear to have much effect on the activity of either, but that is really due to the defects of the method of investigation, which involves comparatively small extensions. Further, the mixings used are probably not suitable for the two accelerators concerned, though they are very useful generally for comparing different materials.

In order to provide a more reliable comparison between the two accelerators, they were incorporated into mixings of plantation sheet 100, sulphur 10, D.P.G. ½, and (A) zinc oxide 5 or (B) light magnesium carbonate 5. A^1 and B^1 are similar mixings containing accelerene, allowance again being made for the moisture present. The four mixings were vulcanised for various lengths of time in the form of slabs, from which ring test pieces were cut for testing on the Schopper machine. The results of these tests are shown in Table II.

TABLE II.

Mixing A. Time of vulc. at 142° C.	Breaking load kg./mm².	Final length, %.	Toughness 600% load, kg./mm².
1 hr.	1·44	847	0·41
¾ „	1·30	702	0·48
½ „	0·99	573	0·62
¼ „	0·43	502	0·73
Mixing A^1.			
20 min.	1·33	875	0·31
30 „	1·08	804	0·35
50 „	0·34	665	—
¼ hr.	0·25	605	—
Mixing B.			
30 min.	0·50	710	0·23
¾ hr.	0·95	948	0·24
1 „	0·88	908	0·30
Mixing B^1.			
15 min.	0·30	886	0·24
22 „	1·08	920	0·41
35 „	1·35	894	0·44

Comparison of the tensile figures for A and A^1 shows that, as far as strength is concerned, they are very similar. A^1 vulcanises slightly faster than A,

indicating that accelerene is the better accelerator of the two. It is noteworthy, however, that D.P.G. has a greater toughening effect than accelerene. The result of comparing B and B¹ is somewhat similar, except that the strength of the D.P.G. and magnesia mixing, B, is very poor.

From this preliminary investigation, then, it may be concluded that accelerene and the accelerator under consideration are not very different in activity; but it is also obvious that they are somewhat different in action.

In using such a substance the first necessity is to know the proportions of sulphur and accelerator which will give the most satisfactory results from the point of view of tensile properties, rate of cure, flatness of cure, toughness, and ageing. In the absence of any theoretical guidance, beyond very general statements, the only means of determining the optimum quantities of sulphur and accelerator is to adopt the method of trial and error, which was accordingly done.

To hard fine Para containing 5% of zinc oxide were added quantities of sulphur ranging from 1¼% to 15% of the rubber. To these different batches were again added quantities of D.P.G. ranging from ½% to 1% on the rubber, so that practically all possible combinations of sulphur and accelerator were investigated. The results are indicated in Table III.

1·5 [illegible] mixings
[illegible] cures at
142°.
Others at 135°

TABLE III

% Sulphur.	% D.P.G.	Time of vulcanisation at 135° C. Hr.	Breaking load. Kg. mm².	Final length. %	Toughness at 800% load Kg./mm².
1¼	½	¾	0·20	1062	0·09
		5/4	0·47	1071	0·16
		1	0·45	1060	0·12
		1¼	0·41	1093	0·11
		1½	0·37	1038	0·13
		1¾	0·33	1028	0·27
		2	0·81	1018	0·25
		2¼	0·87	994	0·29
		2½	0·73	999	0·23
		3	0·74	1040	0·22
1½	½	1	1·10	964	0·40
		1¼	1·04	967	0·42
		1½	1·30	956	0·49
		2	1·51	985	0·41
		2½	1·01	1007	0·34
2	0	¾	0·69	1063	0·18
		7	0·51	988	0·30
2	½	¾	0·31	1006	0·13
		¾	0·58	1056	0·15
		5	0·64	1016	0·24
		8	0·96	990	0·28
		10	0·44	927	0·22
2	¾	½	0·72	1008	0·26
		3	0·89	984	0·33
		¾	0·99	966	0·34
		4	1·03	900	0·38
		¾	0·96	940	0·35
2	¾	¾	0·78	991	0·29
		1¼	1·19	959	0·53
		1½	1·22	939	0·55
		2½	1·19	932	0·57
		2¾	1·31	927	0·65
2	1	¾	0·93	961	0·40
		1	1·27	927	0·62
		1¼	1·48	907	0·62
		1½	1·76	922	0·91
		1¾	1·72	897	1·04
5	0	¾	1·20	1036	0·34
5	½	¾	1·16	955	0·55
5	¾	¾	0·99	1034	0·22
		3	0·73	948	0·32
		4¼	0·96	972	0·38
		5¼	0·98	974	0·37
		6	0·94	914	0·47
5	¾	¾	0·69	981	0·42
		2¾	1·16	939	0·58
		3	1·31	934	0·63
		3¼	1·18	899	0·68
		7¼	1·23	923	0·84
5	¾	¾	1·32	969	0·58
		1¼	1·43	904	0·84
		1½	1·47	857	1·05
		2	1·43	865	0·96
		2¼	1·78	853	1·06
5	1	¾	1·40	946	0·70
		¾	1·63	901	0·99
		1	1·72	859	1·36
		1¼	1·72	821	1·54
		1½	1·80	815	1·69
7½	½	¾	1·31	978	0·50
		4	1·28	938	0·52
7½	¾	¾	0·55	997	0·21
		2¼	0·84	912	0·48
		3	1·06	922	0·56
		3¼	1·02	909	0·54
		4¼	0·91	965	0·38
7½	¾	¾	1·08	982	0·43
		1¼	1·05	922	0·68
		1½	1·23	936	0·62
		2	1·49	927	0·78
		2¼	1·67	843	0·83
		Min.			
7½	¾	¾	50	1·26	944	0·60
		Hr.			
		1¼	1·50	893	0·92
		1½	1·42	855	1·05
		1¾	1·53	794	1·41
		2	1·68	804	1·44
7½	1	¾	1·40	925	0·73
		1	1·66	870	1·18
		1¼	1·64	805	1·52
		1½	1·79	788	1·59
		1¾	2·13	787	2·24
10	½	¾	1·16	973	0·46
		2¼	1·18	955	0·52
		3	1·33	959	0·60
		3¼	1·56	930	0·57
		5¼	1·42	927	0·71
10	¾	¾	0·85	924	0·47
		1¼	0·89	923	0·45
		2	1·01	924	0·53
		2¼	1·15	939	0·59
		2¾	0·80	849	0·81
10	¾	¾	0·91	935	0·49
		1¼	1·21	893	0·77
		1½	1·18	856	0·87
		1¾	1·11	909	0·95
		2	1·02	813	0·90
10	¾	¾	1·13	855	0·83
		¾	1·41	876	0·97
		1¼	1·36	888	0·94
		1½	1·60	883	1·19
		2	0·93	713	1·34
10	1	¾	1·05	936	0·59
		¾	1·36	894	0·98
		¾	1·76	870	1·24
		1	1·48	799	1·66
		1¼	1·61	760	1·78
15	½	¾	0·99	925	0·54
		2¼	1·04	870	0·65
		2½	0·87	780	1·07
15	¾	¾	0·80	939	0·43
		1¼	0·79	894	0·62
		2	0·95	832	0·70
		2¼	0·81	823	0·70
		2½	0·44	871	0·34
15	¾	¾	1·20	925	0·66
		¾	1·18	883	0·78
		1¼	1·44	869	0·96
		1½	1·33	835	1·15
		2	0·84	720	1·31
15	¾	¾	1·23	918	0·71
		¾	1·45	881	1·00
		1	1·63	878	1·17
		1¼	1·35	791	1·45
		1½	0·78	810	1·74
15	1	¾	1·27	929	0·73
		¾	1·30	853	1·03
		¾	1·63	845	1·47
		1	1·84	777	1·86
		1¼	1·54	735	2·34

Hard fine Para was used throughout, in order to be reasonably certain of dealing with a normal rubber. The mixings were made up in each a way as to eliminate errors arising from slight deviations in the proper quantity of sulphur, and the rubber was mixed so that the amount required for the experiment would be as nearly uniform as possible. After the mixings had been prepared, they were heated over a range of cures in a "daylight" press, in the form of slabs. The time necessary being in some instances short, the heating was carried out at 135° C., except for the controls and for mixings containing 11½% of sulphur, which were heated at 142°. When the

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mixings had been vulcanised, ring test pieces were cut from the slabs and tested on the Schopper machine, giving the tensile data shown in Table III. Each observation of load and final length is the average of three readings. Before proceeding to general conclusions, the properties of each mixing are considered in detail.

No attempt was made to vulcanise a control mixing containing 1½% of sulphur. The addition of ½% of D.P.G. to such a mixing enables it to be properly vulcanised, although the tensile strength is very poor. It appears to be fully cured in about 3 hours at 142° C. Increasing the D.P.G. to ¾% improves the strength slightly, and reduces the time required to 2 hours. The third mixing of the series containing 1% of accelerator possesses quite good tensile strength, and is fully cured in 1½ hours. It is very noticeable that the addition of D.P.G. causes a marked increase in the toughness of the mixing, the increase becoming greater each time the accelerator is augmented. It appears probable that when these mixings are vulcanised beyond their maximum tensile point they become softer. This may be an indication of devulcanisation, due to prolonged heating in the presence of an active accelerator and a small quantity of sulphur.

In the case of the 3% sulphur mixings it was possible to compare the control with the accelerated mixings. The addition of ½% of D.P.G. to the stock makes practically no difference to its properties beyond reducing the time of vulcanisation, as indicated by the maximum strength, from 12 hours to 8 hours at 135° C. Further increase in the quantity of accelerator up to ¾% ensures an increase in both strength and toughness, and brings about a reduction in the time of vulcanisation to 4 hours. The ½% and 1% mixings show a very decided improvement in tensile properties. The toughness of each mixing increases with the addition of D.P.G., and in both cases flat curing properties are beginning to be evident. The strength attained by the last of the 3% sulphur series is noteworthy when considered alone, and is outstanding when contrasted with that of the control.

The same features may be noticed by referring to the tensile figures for the 5% and 7½% sulphur mixings. The various effects, however, are becoming very much intensified with increase in the quantity of sulphur. The only exception to this is that in the case of the two mixings containing only ½% of accelerator, the tensile strength is less than that of the control. The 7½% sulphur mixing with 1% of D.P.G. gives a strength of 2·13 kg. per sq. mm.

The 10% and 15% sulphur mixings represent a retrogression. They do not reach the same strength or toughness as the previous mixing, although there is a slight increase in acceleration. Reduction in strength with the addition of small quantities of D.P.G. is again noticeable. In spite of the retrograde movement with respect to tensile properties, both series of mixings are still satisfactory as regards strength, especially those containing larger quantities of accelerator.

In order to demonstrate the general features of D.P.G. as an accelerator, and to indicate clearly the type of mixing in which it should be used, a series of diagrams have been made. Fig. 1 shows how the maximum load obtained over the range of cures

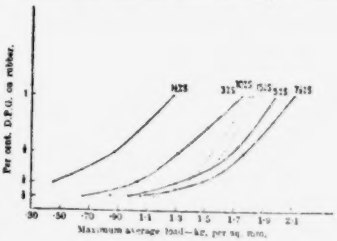

FIG. 1.

behaves with different quantities of accelerator in mixings containing different quantities of sulphur. After the points on this diagram had been plotted, it was found that they lay on a series of curves which corresponded to the different proportions of sulphur. This is the case, also, for the other diagrams, except for Fig. 4, which is an indication that the quantity of sulphur present is one of the main factors determining the properties of an accelerated mixing. Reverting to Fig. 1, it is clear that for every mixing, increase in the quantity of D.P.G. produces an increase in strength, the increment being greater when the quantity of accelerator present is small than when it is already large. As sulphur is added up to 7½%, the curves move further away from the D.P.G. axis and do not intersect, showing that the breaking load becomes greater as the proportion of sulphur is increased, no matter what quantity of accelerator is present. The 10% and 15% curves

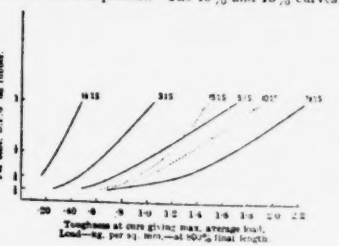
Per cent. D.P.G. on rubber.
1
¾
½
¼
·20 ·40 ·6 ·8 1·0 1·2 1·4 1·6 1·8 2·0 2·2
Toughness at cure giving max. average load.
Load—kg. per sq. mm.—at 800% final length.

FIG. 2.

lie, however, nearer the vertical axis, which indicates that for all quantities of D.P.G., adding sulphur beyond 7½% causes the strength to decrease. This result cannot be due to the addition of sulphur alone, for a 10% sulphur mixing containing no accelerator possesses a better tensile strength than

one containing 7½%; it must therefore be due to the sulphur and D.P.G. together.

Fig. 2 shows the relation between the toughness (measured by the load required to produce a final length of 800%) of the mixings when they are at their maximum strength, and the quantity of accelerator present, for the different proportions of sulphur. This is thus a comparison of the toughness of the mixings under similar conditions of cure. As noted above, points when plotted lie on curves corresponding to the proportion of sulphur in the mixing. Further, however, for small quantities of sulphur the curves are straight lines, showing that the additional toughness due to the accelerator is practically proportional to the quantity of D.P.G. present. For all the curves the toughening effect increases with the addition of accelerator. When the amount of sulphur present is large, the increase is greatest when the proportion of D.P.G. is small. As regards their position relative to the D.P.G. axis, the curves on Fig. 2 are similar to those on Fig. 1, the toughening effect increasing for all quantities of D.P.G. up to 7½% sulphur and diminishing for quantities of sulphur greater than that. Toughness and strength thus vary similarly in mixings accelerated with D.P.G.

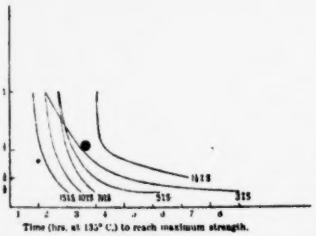

FIG. 3.

Fig. 3 shows the time (at 133° C.) required to reach the maximum strength, plotted against quantity of accelerator. Again, curves for the different proportions of sulphur can be drawn. Their position with respect to the D.P.G. axis indicates that as the quantity of sulphur is augmented, the time of cure is reduced, and there is no break in the continuity of this law at the 7½% curve. From 1½% to 15% sulphur the curves gradually approach the vertical axis. The portions of the curves above the ½% line are practically parallel to the D.P.G. axis, indicating that there is almost no increase in acceleration when more than ½% of D.P.G. is added. The acceleration is produced greatest with small quantities of sulphur, and the lower part of the curves being almost parallel to the time axis, the maximum increase in acceleration is obtained with proportions of accelerator less than ½%. The slope of the lower part of the curves gradually diminishes as sulphur is added, so that for large proportions of sulphur a small quantity of D.P.G. is almost as effective in reducing the time of cure as a large quantity.

An attempt has been made in Fig. 4 to show that when use is made of an accelerator, certain limitations are imposed in order that the good qualities imparted by such a material may be utilised to their fullest extent. The three properties which are most likely to require consideration in producing a new mixing are time of vulcanisation, strength, and toughness. Fig. 4 shows maximum strength plotted against the

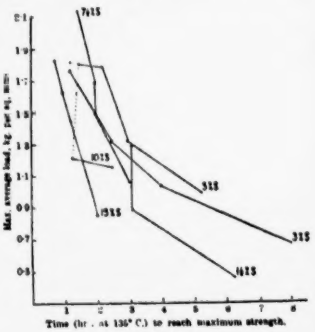

FIG. 4.

time (at 135° C.) required for its development. A similar diagram could be drawn for toughness. For convenience in identification purposes points representing mixings containing the same quantity of sulphur have been connected up. It will be observed that the majority of the mixings reach their best strength between 1 hour and 3 hours at 135° C. A few of very low strength take longer. This indicates that if a mixing is to be produced containing D.P.G. possessing good tensile properties, other circumstances must be such that it can be heated for about 1 hour at 135° C. subject to the influence of the compounding ingredients used. A similar diagram for toughness is not shown here, but it should be noted that satisfactory mixings containing D.P.G. will have certain definite limits of toughness between which they will lie, again subject to the effect of other ingredients. This is very important technically, as it indicates that radical alterations may have to be made in the compounding ingredients of a technical mixing when this accelerator is added in order that the accelerated mixing may possess exactly similar properties to the original, or conform to some specification. In some cases it is conceivable that the use of D.P.G. may be impossible.

Hitherto, in discussing the results, it has been assumed that the time taken to reach the maximum strength indicated when the mixings were fully

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vulcanised. In Table IV. are given times of vulcanisation which are considered suitable for technical work, together with the strength developed.

TABLE IV.

% Sulphur.	% D.P.G.	Time of vulcanisation at 135° C. Hrs.	Strength, kg/mm².
1½	½	0	0·42
	1	3	0·88
	2	3	1·28
2	½	3½	0·58
	1	3	0·99
	2	2	1·22
	3	1	1·48
3	½	2	0·73
	1	1½	1·18
	2	1	1·43
	3	¾	1·41
4½	½	2½	0·94
	1	1½	1·29
	2	1	1·50
	3	¾	1·60
10	½	2½	1·01
	1	1½	1·18
	2	1	1·41
	3	¾	1·36
15	½	2	0·85
	1	1½	1·44
	2	¾	1·45
	3	½	1·30

These have been arrived at by taking the first cure giving a reasonably good strength. In most cases the maximum strength is not reached until the mixing has been heated for a considerably longer period, and in all instances except for a few mixings containing a small quantity of sulphur or a small quantity of accelerator, there is a long range of time over which good tensile properties may be obtained. For technical work, therefore, most of the above mixings possess a very big margin of safety. Reference to Table III. shows that this accelerator produces mixings which are very much flatter curing than the controls. This must be reckoned as one of the most valuable properties of D.P.G.

From the above investigation it may be concluded that the best type of mixing to use with this accelerator is one in which the quantity of sulphur is in the neighbourhood of 7½% of the rubber, and the accelerator approximately ½% of the rubber. The quantity of sulphur necessary to bring out the full effect of D.P.G. is thus rather in excess of what might have been expected.

Hitherto, this work has dealt with mixings which are practically pure, containing only sufficient zinc oxide to activate the D.P.G. The possibility arises, however, that the conclusions may not be valid for compounded mixings particularly when active ingredients are present. As it is certain that if the presence of active fillers does not invalidate the previous results, inactive fillers will not, it is sufficient to investigate how D.P.G. behaves in mixings containing large quantities of zinc oxide and light magnesium carbonate. Litharge is not considered, as it is such a good accelerator by itself that it does not appear necessary or advisable that it should be used along with a powerful organic accelerator. Accordingly, the next portion of the experimental work dealt with mixings containing large quantities of zinc oxide and of light magnesium carbonate. In order to reduce the work necessary to a manageable amount, four representative mixings were chosen in such a way that the conclusions from their behaviour would be general for any combination of accelerator and sulphur. Two of the mixings contained a large quantity of sulphur with large and small quantities of D.P.G. respectively. The other two mixings contained a small quantity of sulphur with large and small quantities of D.P.G. respectively. Again, instead of adding different amounts of filler to these control mixings, the largest quantity of zinc oxide and of magnesia which can be efficiently used in rubber, was fixed upon as a suitable quantity to investigate. This procedure is justifiable in that addition of these substances up to that amount causes a progressive change in the physical characteristics of the rubber, and maximum effects were therefore being investigated. The actual quantity of filler which was added, namely 30% of zinc oxide, and 15% of light magnesium carbonate, had already been determined in previous experiments, and is in accordance with that indicated by Wiegand (India Rubber J., 1920, 60, 423).

Each mixing was cured over a range so as to exhibit the maximum tensile properties, and ring test pieces from each heat were tested on the Schopper machine. The resulting tensile figures are shown in Table V. For convenience the tensile figures for the controls have been abstracted from Table III., and are shown alongside those of the corresponding zinc and magnesia mixings. The figures given in the table are again average values obtained by breaking three rings.

TABLE V.

Cure at 275°F.	Rubber 100, sulphur 7½, D.P.G. 1. With 5% zinc oxide. Load. kg./mm.²	Final length. %	Tough-ness load. kg./mm.²	With 30% zinc oxide. Load. kg./mm.²	Final length. %	Tough-ness load. kg./mm.²	With 5% zinc oxide and 15% light magnesium carbonate. Load. kg./mm.²	Final length. %	Tough-ness load. kg./mm.²
¼	—	—	—	—	—	—	1·33	807	0·79
½	1·40	925	0·41	—	—	—	1·61	793	1·28
¾	1·60	870	0·59	1·61	844	0·77	1·66	721	1·83
1	1·64	805	0·67	1·63	833	0·83	2·05	720	1·87
1½	1·79	788	1·01	1·64	810	1·09	2·10	694	2·16
2	2·13	787	1·31	1·66	786	1·26	—	—	—
2½	—	—	—	1·60	777	1·38	1·70	690	1·48
3	—	—	—	1·48	874	1·08	—	—	—
	Rubber 100, sulphur 7½, D.P.G. ½%.								
1½	0·55	987	0·13	—	—	—	—	—	—
2½	0·94	912	0·27	0·81	874	0·35	1·30	828	0·48
3	1·06	923	0·36	0·74	829	0·40	1·61	807	0·74
3½	—	—	—	—	—	—	1·60	882	0·61
4	1·02	909	0·30	0·86	747	0·41	1·43	843	0·79
4	—	—	—	0·85	789	0·49	1·30	843	0·89
4½	0·91	883	0·38	0·81	861	0·44	1·51	832	0·90
5	—	—	—	0·72	739	0·52	—	—	—
	Rubber 100, sulphur 3, D.P.G. 1.								
½	0·93	961	0·22	—	—	—	1·37	822	0·84
1	1·37	934	0·35	—	—	—	1·64	784	1·15
1	1·48	867	0·45	1·23	870	0·52	1·61	764	1·41
1½	1·76	922	0·48	—	—	—	1·75	790	1·38
1½	1·73	907	0·45	1·42	883	0·43	1·66	785	1·49
2	—	—	—	1·49	851	0·77	2·00	739	1·69
2½	—	—	—	1·54	830	0·88	—	—	—
2½	—	—	—	1·75	833	0·95	—	—	—
3	—	—	—	1·60	791	0·91	—	—	—
	Rubber 100, sulphur 3, D.P.G. ½.								
2	0·21	1000	0·09	—	—	—	—	—	—
2½	0·58	1056	0·10	—	—	—	—	—	—
3	0·44	1013	0·12	—	—	—	—	—	—
6	—	—	—	0·29	730	0·24	0·43	747	0·33
7	—	—	—	0·50	949	0·24	0·61	804	0·31
8	0·64	990	0·18	0·57	891	0·23	0·67	885	0·27
9	—	—	—	0·56	891	0·23	0·60	848	0·26
10	0·44	997	0·15	0·19	884	0·22	0·45	880	0·21

With mixings containing a large quantity of sulphur and 1% of accelerator, the addition of zinc oxide causes a reduction in strength, and also probably slows down the rate of vulcanisation. It produces, however, a slightly tougher rubber, this effect being

rather more marked at an advanced state of cure. The addition of magnesia to the mixing decidedly improves its qualities. Increased strength is obtained from a rubber already outstanding in this respect, coupled with a considerable increase in toughness, rendering the magnesia mixing superior to the zinc mixing. The addition of magnesia also appears to produce further acceleration in the rate of vulcanisation.

Similar effects are noticeable with mixings containing a large quantity of sulphur and a small quantity of D.P.G. The control mixing in this instance—not a particularly good one in respect of tensile properties—is not improved by the addition of zinc oxide. The strength shows a distinct tendency to drop. The maximum strength is not attained until 4½ hrs., as against 3 hrs. for the control. The only improvement effected by the addition is a slight increase in toughness. Very different is the action of the magnesia. The strength is very much increased, and the rate of cure of the control not only maintained, but probably slightly increased. Again, there is a great increase in toughness. Perhaps the most remarkable feature of this magnesia mixing is its flat-curing property. The strength remains good from 2½ to 4½ hrs., and though the mixing is gradually increasing in toughness the increase is not great. The other magnesia mixing possessed the same flat-curing properties as regards strength, but not as regards toughness.

Mag. cont. mixing is flat curing

The mixings containing a small quantity of sulphur with a large quantity of accelerator show the effects due to the addition of the two fillers better than any others. The addition of zinc oxide in this case produces practically no alteration in strength, and there is a slight increase in toughness. The rate of cure, however, is slowed down very considerably, the increase in the time required to reach the maximum strength being 1½ hrs. on an original heat of 1½ hrs., or 100%. The zinc oxide mixing shows rather a long range of cures which give good strength. The action of the magnesia is very marked. There is an increase in strength, coupled with a slight increase in the rate of cure. A very great toughening effect is produced. In respect of strength the mixing is very flat curing. In general qualities this magnesia mixing is very much superior to the corresponding zinc one.

The last lot of mixings containing a small quantity of sulphur along with a small quantity of D.P.G. is very disappointing. The control in this instance has poor tensile properties, and the addition of fillers does not improve matters. Both zinc oxide and magnesia seem to slow down the rate of vulcanisation of the already slow-curing control.

Considering these results generally, it is evident that the effects produced by the addition of zinc oxide to a mixing accelerated with D.P.G. are not very desirable. Firstly, no increase in strength is produced, there being in fact a slight diminution, which; however, is negligible, particularly as the accelerated mixings are usually very strong. The toughening effect is less than would have been expected. That is, the zinc oxide has a smaller effect on the accelerated mixing—which has already been toughened—than it has when no accelerator is present. The magnitude of the toughness induced by zinc oxide varies with different types of mixings, increasing as the sulphur decreases or with decrease in the quantity of accelerator. It is a well-known fact that the addition of an active filler to a mixing already containing another active filler produces less increase in toughness than if the second filler had been added to a pure stock. In the case under consideration, sulphur and accelerator behave as if they were equivalent to an active filler, so that the full benefit of the toughening powers of the zinc oxide is not obtained. Another disadvantage of using D.P.G. in zinc oxide mixings is the reduction in the rate of cure produced by so doing. This retarding effect of the zinc oxide is greatest when the quantities of accelerator and sulphur present are small. It can be shown that zinc oxide alone has no effect on the time of cure as measured by the time taken to reach maximum strength, so that the retardation noted above must be due to the zinc oxide and D.P.G. conjointly. It is, in fact, a reversal of the activation process. The activity of D.P.G. must be brought up to a maximum by the addition of zinc oxide and then slowly reduced. The magnitude of such an effect would obviously be influenced by the amount of sulphur and accelerator present, and, in particular, it would be greater with small amounts of accelerator. From the behaviour of the mixings investigated, it is concluded that D.P.G. should not be used in zinc oxide mixings unless it is permissible to have present as much as 1% of D.P.G. on the rubber along with a fairly high sulphur content.

The general effects of the addition of light magnesium carbonate to D.P.G. mixings are very different. For all mixings except when accelerator and sulphur are both present in small quantities, the addition of magnesia produces an increase in strength, an increase in the rate of cure, and a toughening effect very similar to what would be obtained if no accelerator had originally been present. The increased strength is most marked when a small quantity of accelerator is used along with a large quantity of sulphur. The augmented toughness is perhaps most marked with a small quantity of sulphur and a large quantity of accelerator. Although it fails to effect any improvement in mixings where both the sulphur and accelerator content are low, the mixings examined above are sufficient to show that in magnesia mixings the good properties of this accelerator are exhibited to their fullest degree.

Hitherto, nothing has been encountered which would indicate that as an accelerator D.P.G. behaves any less efficiently in compounded mixings than in mixings containing nothing but rubber, sulphur, and sufficient zinc oxide to activate it. However, in making experiments with accelerated mixings containing brown rubber substitute, considerable trouble was experienced due to porosity. It has since been noted (Lefebure, India Rubber J., 1923, 66, 932) that D.P.G. does not give good results with mixings containing white substitute. To investigate this

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matter, a control (113½ pts.) consisting of hard fine Para 100, zinc oxide 5, sulphur 7½, and D.P.G. 1, was tested alone and with increasing quantities of brown substitute as shown in Table VI. The control and the first four mixings were heated in an autoclave press in the form of slabs for ¾ hr. at 135° C. The last mixing was heated in the same way for 1 hr. at 142° C. In none of the samples could any signs of porosity be detected.

TABLE VI.

Mixing.	Cure	Load. kg./mm².	Final length. %	Toughness 700% load. kg./mm².
Control ..	½ hr. ..	1·80 ..	344 ..	1·47
17½ Sub. ..	½ „ ..	1·71 ..	346 ..	1·38
25 „ ..	½ „ ..	1·70 ..	336 ..	1·34
35 „ ..	½ „ ..	1·68 ..	331 ..	1·36
40 „ ..	½ „ ..	1·62 ..	338 ..	1·03
40 „ .. *	1 „ ..	0·80 ..	671 ..	—

* With additional 5% of light magnesium carbonate.

As might have been expected, with increase in the quantity of substitute the strength diminishes. The mixings also become rapidly softer, and that may be taken as an indication of the rate of cure being slowed down as the substitute is increased. Magnesia was added to the last mixing in the hope that it would effect an improvement. The reverse is the case. The porosity encountered in mixings of this type is probably due to the slowing down of the rate of cure. From these results it would appear that D.P.G. should not be used along with mixings containing brown substitute. Although figures are not given, the same conclusion applies to white substitute. Probably the reason for this incompatibility of substitutes and accelerator is to be found in the traces of acid always present in these materials

Another factor which requires consideration when an accelerator is added to a mixing is its influence, if any, upon the ageing properties of the rubber. There has, perhaps, always been some suspicion that rubber containing accelerators is liable to perish more rapidly than ordinary mixings. This point was investigated for D.P.G. by subjecting two of the mixings to an artificial ageing test in an oven. As there is a general similarity in behaviour amongst the mixings dealt with, the choice of two, as being sufficient to indicate the ageing qualities of D.P.G. mixings in general, seems legitimate. The mixings chosen contained large and small quantities of sulphur respectively, with enough D.P.G. in each case to ensure that the mixings would possess reasonably good strength when properly cured, and would also be fairly fast curing. Both mixings contained hard fine Para 100, and zinc oxide 5, whilst A contained in addition 7½ pts. of sulphur and ½ of D.P.G., and B 3 of sulphur 1 of D.P.G. Large batches of A and B were mixed, and sufficient of both vulcanised to provide 55 rings for testing on the Schopper machine. Each mixing was vulcanised for two different times, one of which was supposed to be below that giving the optimum tensile figures, while the other was supposed to be that giving the maximum strength. However, the heats for A turned out to be rather long, and both are actually over-cures. In order to eliminate errors in vulcanisation, as many slabs of each mixing were heated together as practical difficulties would allow. After curing, five rings of each heat were tested, and the remainder of the slabs put into a ventilated oven which was automatically kept at a temperature of 70° C. Each day after this slabs were removed, allowed to cool, and tested. Tensile figures for every second day are shown in Table VII., readings representing averages being obtained by breaking 5 rings.

With mixing A the loads obtained for both cures gradually diminish from the start, which shows that it has been over-cured. In spite of this the load shows no sudden decrease until the 10th day. This is better than the usual behaviour of rubber-sulphur mixings. The strength remains quite noteworthy for 6 days. As the rubber ages there is a gradual increase in toughness, but not as much as might have been expected. The longer cure represents a rather bad over-cure, and the strength breaks down after two days, as an unaccelerated mixing would do under similar circumstances. Considering that the short cure is an over-cure, mixing A possesses very good ageing properties.

Mixing B appears to be very outstanding in ageing qualities. In the case of the short cure the load slowly rises to a maximum which is reached in 5 days, and then gradually diminishes. The long cure reaches its maximum in two days. Both heats must, therefore, have been under-cures, although the longer heat is practically a correct cure. In neither case is there much increase in toughness, nor does either heat show signs of breaking up after 10 days in the oven. The strength of the longer heat is still at 1·41 kg. per sq. mm. after 10 days, which is quite outstanding.

TABLE VII.

Mixing A.	Cure ½ hr. at 135° C.			Cure 1½ hr. at 135° C.		
Age in days	Load. kg./mm².	Final length. %	Toughness 700% load. kg./mm².	Load. kg./mm²	Final length. %	Toughness 700% load. kg./mm²
0 ..	1·63	370	0·94 ..	1·76	373	0·96
2 ..	1·70	384	0·91 ..	0·52	573	0·81
4 ..	1·56	384	0·73 ..	0·69	539	0·99
6 ..	1·39	396	0·71 ..	0·25	542	—
8 ..	1·34	717	0·79 ..	0·18	374	—
10 ..	0·40	579	0·74 ..	0·18	340	—
Mixing B.	Cure ½ hr. at 135° C.			Cure 10 hr. at 135° C.		
0 ..	1·56	345	0·89 ..	1·68	367	0·95
2 ..	1·63	356	0·90 ..	1·70	370	0·94
4 ..	1·65	366	0·87 ..	1·61	365	0·86
6 ..	1·49	379	0·82 ..	1·44	354	0·85
8 ..	1·37	341	0·81 ..	1·45	350	0·84
10 ..	1·34	361	0·81 ..	1·41	356	0·82

From this it is evident that D.P.G. mixings show good ageing qualities when subjected to artificial ageing. On the whole, it is probable that mixings containing a small quantity of sulphur age better than those containing a large quantity, but there appears to be not the least danger in using a large quantity. The smallness of the increase in toughness as D.P.G. mixings age may prove a valuable property.

Besides the possibility of the use of an accelerator spoiling the ageing properties of rubber, another contingency which has to be guarded against is the possibility of the accelerator being sufficiently active to cause premature vulcanisation while mixing operations are being carried out, or during subsequent calendering or extruding of the mixing. This phenomenon is one which does not lend itself very

readily to strictly accurate investigation. However, an attempt has been made to deal with the problem in the following way. The mixing chosen contained rubber 100, zinc oxide 5, sulphur 7½, and D.P.G. 1%, and was one of the fastest curing D.P.G. mixings obtainable. Small portions of the mixing were put into a mould similar to those used for the oil-bath method of heating (Comm. Netherlands Govt. Inst., 1917, 139). After clamping up, this mould was placed in a water-bath which could be kept at any desired temperature up to boiling point, and allowed to remain for 5 hours. Samples were heated at 70°, 78°, 88°, 93°, and 97° C. After heating, each sample was carefully examined for signs of curing, a good test being to note the behaviour on passing through a hot mill. The samples heated at 70° and 78° showed no signs of vulcanisation. That heated at 88° was just set. In the case of the 93° and 97° samples, there was no doubt that some vulcanisation had taken place. The critical temperature of this accelerator is, therefore, somewhere about 88° C. That is to say, below that temperature there is either no vulcanisation, or the process is so slow as to escape detection. There is, however, another factor to be considered in connexion with premature vulcanisation, that is the rapidity with which the acceleration increases as the temperature rises above the critical value. The actual investigation of this at low temperatures would be laborious if not impossible, but from the known acceleration at 135° C. it appears that the acceleration will not increase sufficiently rapidly round about 100° to render premature vulcanisation a danger. This becomes more evident when the actual temperature reached on a mixing mill is considered. The temperature of several batches was taken immediately after removal from the mixing mill. As these batches were from 50 to 100 lb. in weight, and were in the form of compact rolls, the temperature of the centre of a roll will be a good indication of the temperature reached on a mixing mill. This was observed for a variety of technical mixings and found to vary from 81° to 85°, which is below the critical temperature for D.P.G. There should, therefore, be little danger of premature vulcanisation in the case of D.P.G. mixings, particularly when it is remembered they will only be at that temperature for a short time.

In considering the milling and mixing of accelerated mixings, another interesting point arises. It is well known that a number of organic accelerators have a marked depolymerising effect on rubber, and therefore they may be used to reduce the time of grinding necessary before solid materials can be incorporated. D.P.G. possesses this property in no inconsiderable degree, as will be seen by the following experiment.

A batch of rubber was ground for 20 minutes and 1% D.P.G. added during the last two or three minutes. Another similar batch was ground for the same length of time, but the 1% D.P.G. was added at the start. When solution viscosities of the two rubbers had been determined by means of the Ostwald viscosimeter it was found that the first batch gave a viscosity number approximately twice that of the second batch. This indicates that by the addition of D.P.G. to rubber before grinding or at the start of grinding, less time will be required to reduce the rubber to a certain degree of plasticity than if no accelerator had been present.

Summary.

The conclusions reached in this paper may be summarised as follows :—

(1) Diphenylguanidine possesses accelerating powers of the same order as *p*-nitrosodimethylaniline.

(2) Diphenylguanidine improves the strength and toughness of mixings and imparts flat-curing properties.

(3) The optimum quantities of diphenylguanidine and sulphur are ½ to 1% of the former, and 5 to 7% of the latter.

(4) This accelerator gives similar results with mixings compounded with zinc oxide and light magnesium carbonate. It is more satisfactory, however, with large quantities of magnesia than with zinc oxide.

(5) Brown and white substitutes appear to have a retarding effect, and such mixings do not give good results.

(6) Diphenylguanidine mixings possess excellent ageing qualities when subjected to artificial ageing tests, particularly if the sulphur content is low.

(7) There appears to be little danger of premature vulcanisation when this substance is present in mixings.

(8) Diphenylguanidine possesses the property of softening rubber.

In conclusion, the author has to acknowledge his indebtedness to the management of the North British Rubber Co., in whose laboratories the above investigation was carried out, for permission to publish this paper.

Castle Mills, Edinburgh.

W. Speight and Sons, Ltd., Printers, Paton Yard, London, E.C. 4

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Hartjens varied the conditions of manufacture in order to trace the origin of these spots or patches and came to the conclusion that they could be connected with the use of sulphite and bisulphite of soda, or a combination of both. Small amounts of these chemicals seldom produce spots, but larger proportions may produce very dark and distinct spots.

It is, therefore, possible that these dark spots are in some way connected with mould growth and also with the use of sulphite and bisulphite in sheet manufacture. There are insufficient data to explain what the connection may be. Possibly the dark parts retain more moisture than the light and are therefore more prone to develop mould. In any case, the observations call for an investigation of the effect of sulphite and bisulphite on the liability of smoked sheet to go mouldy.

Sodium sulphite is used in only very small quantities to keep the latex fluid, but bisulphite is sometimes used in larger quantities to keep the sheet light in color, owing to the marked objection to so-called "oversmoked" sheet. If found that the use of bisulphite tends to cause mould it would probably be better to risk the sheet being dark in color.

It is known that bisulphite hinders the drying of crêpe rubber, that is to say, rubber so treated tends to retain moisture, and what is true of crêpe is probably true of sheet. Sheet which tends to rubber vulcanized in comparison with current samples of the same rubber showed only such small variations as would be found with fresh consignments.

It is evident from the foregoing that deterioration need not take place when ordinary pale crêpe or smoked sheet rubber is stored for long periods under suitable conditions.

Fewer data are available as regards the lower grades, but it is probable that these will keep satisfactorily if properly cleaned and dried. But rubber which contains an appreciable proportion of organic impurity and is exposed to conditions under which putrefaction sets in, will rapidly deteriorate.

"XLO" ACCELERATOR

"XLO" is the trade designation of a recently perfected vulcanization accelerator from which excellent results have been obtained. It is specially recommended for automobile tire stocks, inner tubes and high-class mechanical goods. It is magnesiated di-phenylguanidine in the constant proportions of one-third of the former to two-thirds of the latter. From one-quarter to three-quarters of one per cent of the rubber content of a mixing are the recommended proportions of this accelerator to be used in practical work.

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zum Stelle des Rohres über dem Platinquarz als farbloser, amorpher Beschlag absetzte.

Als ich nach beendigter Analyse den unverändert aussehenden Platinquarz prüfte, zeigte es sich, dass er seine Fähigkeit, im Gasstrome weiter zu glühen[1]), vollständig eingebüsst hatte (trotzdem stimmte die Analyse mit der mittels Bleichromat ausgeführten fast genau überein).

Eine Probe stark »activen« Platinquarzes wurde beim Zusammenglühen mit jenem zur Analyse verwendeten Quarz ebenfalls wirkungslos.

Die Asche im Schiffchen wog 0.0200 g (Zinndioxyd) bei 0.1514 g Substanz. Es fehlen somit ca. 0.01 g, die sichtlich zum allergrössten Theil am Glas abgesetzt waren. Es kann sich nach alledem wohl kaum um ein mechanisches Umhüllen des Platins durch das Zinnoxyd handeln[2])

Die »Giftwirkung« des Arsens für Contactmassen ist bekannt[3]). Es ist vielleicht für den einen oder anderen der HHrn. Fachgenossen von Interesse, dass das Zinn eine ähnliche Wirkung ausüben kann.

München, Chem. Laborat. von H. Weil.

83. G. Pellizzari und C. Cantoni: Ueber Diamido-guanidin.

(Eingegangen am 24. December 1904.)

R. Stollé und K. Hofmann theilen in einem der letzten Hefte dieser Berichte[4]) mit, dass sie salzsaures Diamido-guanidin durch Einwirkung von Chlorcyan auf Hydrazin in ätherischer Lösung erhalten haben. Es liegt uns nun daran, festzustellen, dass wir bereits die Einwirkung von Chlor- und Brom-Cyan (1 Mol.) auf Hydrazin (2 Mol.) in wässriger Lösung studirt und dabei das entsprechende Salz des Diamidoguanidins bezw. aus diesem das Pikrat, Chlorplatinat und Benzylidenderivat erhalten haben. Bei Einwirkung von überschüssigem Bromcyan gewannen wir ausserdem das Salz einer cyclischen Verbindung, die wir Guanazin oder *p*-Diimido-hexahydrotetrazin genannt haben.

Das Manuscript der Arbeit haben wir an die Redaction der Gazz. chim. ital. gesandt, die den Empfang derselben unter dem Datum

[1]) loc. cit. S. 11. [2]) Diese Berichte 34, 4080 [1901].
[3]) Diese Berichte 34, 4080 [1901].
[4]) Diese Berichte 37, 4524—4525 [1904].

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31. August 1904 bestätigt, wie man auf dem Umschlag des am 5. October 1904 herausgekommenen Heftes (Gazz. chim. ital. 34, II, Heft 3) liest. Ein ausführliches Referat über unsere Arbeit ist in den Rendiconti della Società Chimica di Roma über die Sitzung vom 23. October (II. Jahrgang, Heft 16, S. 162) erschienen.

Wenn auch die HHrn. Stoll- und Hofmann unsere Arbeit nicht kennen konnten, bitten wir sie doch, unsere Priorität anzuerkennen und uns zu gestatten, das Studium der erhaltenen Producte fortzusetzen.

Genua, Allgem. chem. Univ.-Inst.

54. A. Kliegl: Ueber Phenyl-fluoren

(Mittheilung aus dem chem. Laborat. der Akad. der Wissensch. zu München.)

(Eingegangen am 21. December 1904.)

Von den bei Beginn der vorliegenden, auf Veranlassung von Hrn. Geheimrath v. Baeyer unternommenen Arbeit (1902) bekannten Darstellungsmethoden des Kohlenwasserstoffes erschien, nachdem Triphenylchlormethan durch Gomberg's Synthese[1]) so leicht zugänglich geworden war, am zweckmässigsten die Destillation äquimolekularer Mengen von Triphenylchlormethan und Triphenylcarbinol[2]). Indess ergaben die angestellten Versuche so geringe Ausbeuten, dass die Gewinnung grösserer Mengen Materials auf diesem Wege unmöglich war[3]). Dagegen wurde in der Destillation von Triphenylcarbinol mit krystallisirter Phosphorsäure eine handliche Methode gefunden, die Phenylfluoren mit guter Ausbeute liefert.

Im Verlauf der Untersuchung wurde ferner zur Darstellung des Kohlenwasserstoffes auch von der Reducirbarkeit des Carbinols Gebrauch gemacht. Das Carbinol selbst kann synthetisch erhalten werden durch Condensation von Fluorenon und Brombenzol mittels Magnesium[4]).

[1]) Diese Berichte 33, 3144 u. f. (1900).

[2]) E. u. O. Fischer, Ann. d. Chem. 194, 259 (1878).

[3]) Eine Notiz Gomberg's (diese Berichte 37, 3545 (1904)) veranlasst mich, zu muthmaassen, dass das von E. u. O. Fischer verwendete Triphenylchlormethan — dargestellt aus Triphenylcarbinol und Phosphorpentachlorid — durch Phosphoroxychlorid verunreinigt war. Daher ihre bessere Ausbeute.

[4]) Die vorliegende Arbeit erschien in München im Sommer 1903 als Dissertationsschrift. Eine Mittheilung darüber in diesen Berichten hat sich leider bis jetzt verzögert. Inzwischen haben Ullmann und v. Wurstemberger (diese Berichte 37, 73 u. f. (1904)) die Darstellung von Phenylfluorenol

Plaintiff's Exhibit No. 28 (Page 2)

PLAINTIFF'S EXHIBIT No. 28

Berichte der Deutschen Chemischen Gesellschaft, 1905, volume 38, p. 283-284

Translation

53. G. Pellizzari and C. Cantoni. On Diamido-Guanidin

(Received December 24, 1904)

R. Stolle and K. Hofmann report in one of the last numbers of this Berichte[1]) that they have obtained the hydrochloric acid compound of diamido-guanidine by action of chlorcyan on hydrazine. It is guanidin by action of cholrcyan on hydrazine. It is now incumbent on us to report that we have already studied the action of chlor- and bromcyan (1 mol.) on hydrazine (2 mols.) in aqueous solution and thereby obtained the corresponding salt of diamidoguanidin, and from this the picrate, chlorplatinate, and benzylidene derivatives. By the action of bromcyan in excess we also obtained the salt of a cyclic compound, which we have named guanazine or p-diimido-hexahydrotetrazine.

We sent the manuscript of this work to the editor of the Gazz. Chim. Ital., who noted its receipt as of August 31, 1904, as may be seen from the cover of the issue which appeared on Oct. 5, 1904 (Gazz. Chim. Ital., 34, II, Heft 3). An extensive review of our work appeared in the Rendiconti della Societa Chimica di Roma concerning the meeting of Oct. 23 (vol. 2, No. 16, p. 162).

If Messrs. Stolle and Hofmann were unaware of our work we would ask them to acknowledge our priority and allow us to continue the study of the products obtained.

Genua, General Chem. Univ.-Inst.

(Here follows Plaintiff's Exhibit No. 29, marked side folio pages 90, 91, 92, 93, and 94)

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[1] This Berichte, 1904, v. 37, p. 4524-4525.

COPY

The Institution of Rubber Industry.

DR. LOTHAR E. WEBER on ACCELERATORS.

American Expert's Interesting Survey of Accelerator Usage.

The last meeting of the session of the Institution of Rubber Industry was held at the hall of the Royal Society of Arts, John Street, Adelphi, London, W.C., on Friday, the 12th inst., when Dr. Lothar E. Weber delivered a lecture on the practical uses of accelerators in the U.S.A. Mr. D. Zorn occupied the chair.

The chairman, introducing the lecturer, said that he felt it to be a particular pleasure to occupy the chair that night—which he did unexpectedly—because they had to welcome Dr. Lothar E. Weber, who was the son of Dr. C. O. Weber, whose name was a household word to those who understood the technical side of the history of the industry. One of the things which appealed most to him was the fact that Dr. Weber came from the United States. As they had heard him say before, he felt it to be a particularly desirable thing that all the interests of the Rubber Industry in the United States and in this country should draw together and knit up. In the past there had been too much of an idea that there must be a necessary clash of interests between the American manufacturing industry and the planting industry which was almost entirely British. That notion was gradually passing away—and it was high time, too—because the conditions at present surrounding the industry made it absolutely necessary to get rid of all prejudices and to draw together in every way. He understood that Dr. Weber had spent seventeen years of his life in England, and he (the speaker) felt that they could regard him as a link between the two countries. He did not pretend to know much about the technical side of the Industry—his connection with it was from the financial standpoint—but he knew enough to know that Dr. Weber was one of the most famous chemists in the whole Industry, and that he was known throughout rubber circles in America for his work in that direction. He thought they would feel privileged in listening to him that evening, and on behalf of the Institution extended to him an exceedingly hearty welcome. Before sitting down, he referred to what he called general topics. As some of them were aware, a very important public meeting was held the week before at Winchester House under the auspices of the Rubber Shareholders' Association, and at that meeting a definite policy was put forward which would affect the whole of the Rubber Industry. The speech in which that policy was defined would be printed in pamphlet form during the next few days. He had heard that evening with a great deal of pleasure that that policy had been considered by the committee of that Institution, who had decided to support it in every respect. That was very encouraging because any effort to bring about a conference was apt to be met with a very heavy shower of cold water, and the fact that the Institution had adopted that policy was, he thought, a thing which might be helpful in the efforts he was making towards more harmonious working.

Dr. L. E. Weber then spoke as follows:—

Ladies and Gentlemen, during the last five or six years very marked development has taken place in the United States in the application of accelerators. Prior to, let us say, 1916, the number of concerns using organic accelerators in regular factory operation was small. In the year following, 1916 and 1917, more and more concerns began to interest themselves in the utilisation of these materials, so that to-day scarcely a concern of standing in the industry is known that does not use accelerators as part of their regular factory operation. To the casual student of accelerators, probably, the first thing that impresses him is the large number of substances which appear in the literature on the subject, and are characterised as being accelerators, and as being available for factory procedure. Anyone wishing to utilise an accelerator or accelerators would probably be somewhat bewildered, but as a matter of fact there are relatively few accelerators which have found practical application, because other properties are necessary than the mere fact that the substance in question will accelerate the vulcanizing process.

Qualities of a Good Accelerator; Low Critical Temperature; No Discolouring Effect on Goods or Toxic Effect on Operators; and Low Price.

I think at the outset it might be desirable if I referred briefly to the qualities which a substance must possess in order that it may be qualified and regarded as an accelerator from the practical standpoint. In the first place, there is a question of what may be called the critical temperature of the accelerator; that is to say, the temperature at which the substance begins to exert its accelerating action. This temperature must not be too low—by too low I mean in the vicinity of 220 degrees F.—as otherwise premature vulcanization will take place during the mixing and calendering operations.

Importance of Low Critical Temperature in Large Scale Mixing.

This applies particularly to the large scale mixing operation as it is carried out in the United States to-day, and probably here. It is not at all unusual for a factory in the States to employ eighty-four inch mixing mills with a batch of 400 lb. Such a batch naturally gets very warm. The calendering operation also is done on a large scale basis. Calenders frequently run as fast as thirty-five or forty yards a minute—frictioning calenders in frictioning canvas—so that the heat generated in the milling and calendering operations is more than sufficient to start a premature vulcanization unless the critical temperature of the accelerator is relatively high. This property of premature vulcanization is usually known as scorching. You are familiar with it, and a scorched batch is absolutely useless. One might think the more active the accelerator the lower its critical temperature, but such is not the case. Many of the most active accelerators have relatively high critical temperatures, and this of course makes them very desirable. On the other hand, a substance like thiocarbanilide, a relatively weak accelerator, has a low critical temperature, and in the course of years thiocarbanilide has come to be regarded with disfavour in the United States on account of its scorching tendency.

Another property which an accelerator must have is that it must not discolour the vulcanized stock. Such

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discoloration may be immediate, that is, immediately after the stock is vulcanized, or such discoloration may be subsequent, that is to say, it may develop in the course of time. Aniline formaldehyde, a very desirable accelerator in certain respects, is somewhat of an offender in this respect. The articles are white immediately after being vulcanized, but in the course of time—a week or two weeks—are apt to develop a disagreeable yellowish colour. Paranitrosodimethylaniline is looked on with disfavour for the same reason; it tends to discolour the stock.

Toxic Effect of Various Accelerators.

A third property which the accelerator must have, and a most important one from the point of view of factory operations, is freedom from toxicity. A great deal of trouble has been caused in the United States from accelerator poisoning. Factories have had to shut down because their men got into a condition where they were simply not able to work. The accelerators behave in various ways from the standpoint of their toxicity. Aniline oil, as you know, produces what may be called a constitutional toxicity, affecting not only local portions of the skin, but causing a breakdown of the blood cells, resulting in very disagreeable poisoning. The use of aniline oil to-day in the States is small. There are a few concerns that still use it, and those that do use it are able to do so only because they provide for very thorough and rigid ventilation. The stocks in which they use the aniline oil are apt to be stocks that do not require much milling; that is to say, stocks in which the amount of aniline oil that is vaporised is very small. Various methods have been suggested for counteracting or overcoming the aniline oil poisoning. Giving the afflicted workmen milk is of some value, and I believe the use of acetic acid in small quantities has been fairly successful. But aniline oil is not a very desirable accelerator, on account of its poisonous action. Other forms of poisoning are pronounced dermatitis, that is to say, skin irritation. Hexamethylene tetramine is a real offender in this respect. "Hexa" has been used for a great many years, but a great deal of trouble has been caused by it.

The Element of Freakishness.

The extent of the trouble and its seriousness varies very much with the factory. One factory may have relatively good luck; another may not be able to use it, even the men who wrap the tyres in the wrapping rooms being affected. I know one case where the "hexa" had to be thrown out of the factory on account of the irritation which it caused, and for some months after "hexa" had been entirely eliminated the rash still appeared. It was finally traced to the liners. The liners that were used for several months after the abolition of the "hexa" were those which had been utilized with it, and the small amount in the liners was enough to cause skin irritation to the workmen susceptible to it. Some of the other accelerators are not poisonous; they do not produce the effects that aniline oil produces, neither do they produce dermatitis, but they do evolve irritating gases, which the workmen find very disagreeable, and rightly so. An accelerator such as aniline formaldehyde is very desirable in all respects, but aniline formaldehyde gives off formaldehyde, and the workmen find the fumes most disagreeable.

Then a fourth factor in determining the desirability of an accelerator is its price—of course by price being meant the price per active unit. An accelerator costing 5s. a lb., which is three times as active as one costing 2s. 6d. a lb. is the more desirable product to use. You have, first of all the question of scorching; you have in second place the question of toxicity; you have in third place the question of discoloration; and fourthly question of price; all to be considered in selecting accelerator. I think if you will apply these four conditions to the formidable list which you will find in various publications, you will be narrowed down to relatively few substances that meet all these four requirements.

Use in Moulded Goods.

The application of accelerators varies considerably with the goods in which they are used, or more strictly varies with the procedure or the process by which goods are made. It has been found that accelerators work to best advantage in moulded goods; in fact, think I shall be safe in saying that ninety-five per cent of the moulded goods produced in America to-day contain accelerators. I think that would be a conservative statement to make. I was going to put it at ninety-eight, but I think we can call it ninety-five and be fairly conservative. It has been found that in steam-cured goods accelerators should be used with caution. They are used widely to-day in the States in steam-cured goods—certain accelerators—but one is liable to encounter trouble. It is much easier to over-step the mark in steam-cured goods than in the case of press-cured goods. Of course the same applies to steam-cured and press-cured without the accelerator, but I think it is much more marked when the accelerator is present.

Water Solubility of Accelerators as Affecting Steam Cure.

Certain of the accelerators are soluble in water. "Hexa" is the best example; urea, a very desirable accelerator in several respects, is another example. This water solubility is liable to cause considerable trouble, the trouble being that great variation in the cure is experienced, due to removal of the "hexa" by the steam. Naturally the controlling factor is the extent of thoroughness of the wrapping. On a laboratory scale the operation can be readily controlled, but only with difficulty on a factory basis. For this reason variation in the finished product occurs unless very thorough preventative measures are adopted. The use of accelerators in steam-cured goods, to my mind, should be attempted only after one is thoroughly conversant with the use of accelerators in moulded articles.

Reasons for Non-employment of accelerators in Dry Heat Cure.

In the dry heat cure accelerators have found very little application. In fact I do not think accelerators are used at all in dry heat cure, because the presence of litharge is a disturbing factor—most of the accelerators being poisoned by litharge. Relatively few per cent.—six or eight per cent.—of litharge in a compound makes the action felt quite markedly in killing the activity of the accelerator, or probably, more exactly, in forming lead salts instead of zinc salts. The lead salts, for some reason do not seem to be as active as the zinc, but I do not want to get into any discussion on the theoretical action of accelerators. The fact of the matter is that in dry heat accelerators are not used at all.

I would like now to take up the accelerators which are used most frequently, and state briefly the proportion in which they enter into compounds, and the question of

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ence of the mineral oxide, usually zinc, which in some has to be present and in other cases need not be.

ine Oil Little Used To-Day.

he accelerator which may be called the parent of the erators used to-day is aniline oil. Aniline oil was quite extensively in the United States at one time. is a very desirable accelerator viewed purely from celerating process. Not only does the aniline an accelerating action, but it exerts also a pro- ed solvent action on the rubber, which probably in explains why aniline oil has so little tendency to h. It is used to the extent of about 2 per cent. d on the rubber present. If the compound contains er cent. of rubber the customary amount of aniline ld is 1 per cent. I do not want to give you an ression that that is an absolute rule, it is not; many nufacturers would use as high as 3 or 4 per cent. d on the rubber. As to the amount in the compound it goes into the presses, that is another matter, as niline being quite volatile goes off into the air, and nless the manufacturer who insists on using that unt of aniline oil is doing little else than evaporating bulk of it into the atmosphere. But I think would be perfectly safe in using 2 per cent. pure gum compound, just rubber and sulphur, it would dvisable to go lower, say 1 per cent. It is desirable ave zinc oxide, but not imperative. Aniline ac- ates the process equally well in the presence or nce of zinc oxide. The use of aniline oil to-day is ll; the number of concerns using it has decreased, ause too much trouble was experienced with poisoning.

arbanilide—The Most Widely Used Accelerator

he accelerator which probably followed aniline oil rically is thiocarbanilide; it is the accelerator used t widely; the largest number of firms use thiocar- ide. One must differentiate quite clearly between the ber of concerns using an accelerator, and the total unt of accelerator used in the industry; because there five concerns in the United States—who in their pro- ion probably outweigh the combined production of the r concerns, and of course if one of these very large erns uses a particular accelerator, it naturally in- es the proportion of the total amount of that ac- rator consumed. Thiocarbanilide is probably accelerator which is used by the largest number oncerns, and that notwithstanding its very disagree- tendency to scorching. This tendency is not alto- er an unmitigated evil, because, if the calendering mixing operations are not on too large a scale—if re on a more modest, every-day scale—by carefully olling the conditions of temperature, in fact keeping onditions of temperature down to the really desirable , scorching does not take place, and any evidence corching can be regarded by the works manager as ence of carelessness on the part of the factory rator. To be sure in the warm weather this considera- does not apply. Neither does it apply in the case ery quick curing compounds or in the case of com- nds containing a high percentage of mineral fillers, characterised as "dry" on the mixing mill. In e of its shortcomings thiocarbanilide still holds a high place among accelerators in the United States. e again the customary amount is about 2 per cent. the rubber present. Zinc oxide should be used, as accelerator is much more active in the presence of oxide.

he figure of 2 per cent. which I gave is by no means exact; in very quick-curing compounds 3 or even 4 per cent. is used, though from the standpoint of good ageing, in my opinion, the amount should not be much in excess of 2 per cent.

The Second Accelerator in Popularity (Hexamethylene Tetramine).

An accelerator closely following thiocarbanilide in popularity is hexamethylene tetramine. A great deal of "hexa" poisoning has taken place, but were it not for this poisoning tendency "hexa" would be an extremely desirable accelerator. Its price per active unit is quite low. It can be obtained in large quantities and in a state of reasonable purity. In the case of "hexa" about one to 1½ per cent. is a desirable limit; I would not wish to say that 2 per cent. would cause difficulty, but it is desirable to employ "hexa" in smaller quantities. I think it will be found in the case of "hexa" that increasing the amount of the accelerator does not necessarily proportionately increase the speed of the cure. Of course it is very difficult talk in general terms on the activity of any accelerator, because other ingredients in the compound exert such a powerful influence. This consideration is just the same in the case of the inorganic accelerators. Supposing you ask a man what is the relative amount of, let us say, lime, in comparison with six ounces of sulphur; if you eliminate six ounces of sulphur but of your compound, how much lime should you put in to get the identical result? Of course that question cannot be answered, and just so, or more so, do similar conditions obtain in the case of organic accelerators. But talking generally, I would say that 1½ per cent. of hexamethylene tetramine represents the desirable upper limit. In the case of "hexa" it is desirable to have zinc oxide present —not entirely necessary, but preferable.

Aniline Formaldehyde; A Desirable Accelerator.

Aniline formaldehyde is an accelerator which is increasing in popularity. It is relatively cheap. It can be produced in large quantities, is active, and is relatively free from showing scorching and any toxic action other than slight irritation owing to the fumes evolved; but if the workman is at all careful he need not suffer from the irritating fumes of aniline formaldehyde. Aniline formaldehyde, in my opinion, is a very desirable accelerator. Here again the amount to be used is in the vicinity of 1½ to 2 per cent. based on the rubber present, and zinc oxide is desirable.

Aldehyde Ammonia and the Guanidine Derivatives.

Aldehyde ammonia at one time held some popularity, but it has the objection of being very active and tending to produce scorching. Aldehyde ammonia is much more active than aniline formaldehyde, "hexa" or thiocarbanilide. I would say that 1 per cent. based on the rubber present would represent the upper desirable limit for aldehyde ammonia.

During the last two years guanidine derivatives have come into favour, notably the di-phenyl-guanidine and the tri-phenyl-guanidine. The di-phenyl-guanidine is considerably the more active of the two, but both the "di" and the "tri" are very desirable accelerators. They don't scorch, don't discolour, are non-poisonous, and are obtainable at a reasonably attractive price per active unit. I think that di-phenyl-guanidine and tri-phenyl-guanidine are probably a little more expensive than thiocarbanilide, but not very much so, that is, based on the active unit. These materials are coming into increasing favour in the United States, and in my opinion represent very desirable accelerators. The di-phenyl-guanidine

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should be used in amounts, I would say, not exceeding three-quarters of 1 per cent. based on the rubber present. It is a very active substance. One per cent. might be all right, but I think three-quarters would be a little safer. The "tri" is not quite so active, and I think that 1¼ or 1½ per cent. is safe.

Sodium and Lead Oleate.

There are one or two accelerators that have found application in the past, but are now little used, namely, sodium and lead oleate. They are desirable because they are cheap, and certainly in the case of sodium oleate non-poisonous. Whether the lead oleate is non-poisonous is open to doubt. When lead oleate is used it can be made simply by adding a lead acid to a litharge compound; sodium oleate is used as such. Oleic acid, I think, can be classified as the original organic accelerator.

The accelerating action of oleic acid was accidentally discovered in my father's laboratory in Boston as early as 1904, in the course of some work on castor oil. It was found that rancid castor oil gave a very much better vulcanized product than castor oil which was not rancid. This, of course, led to the theory that the free acid was doing the accelerating, and the addition of oleic acid proved this theory correct. From then onwards in the States oleic acid and the closely related stearic acid were both used in very large quantities for increasing the speed of cure of weak African rubbers, which fifteen or twenty years ago were available in large quantities. Stearic acid is still used in the States, though not as an accelerator, but in place of palm oil for softening stocks on the calender.

Markedly Poisonous Accelerators.

Paranitrosodimethylaniline has some friends in the United States, but it is open to the objection of being markedly poisonous, and the number of concerns using this accelerator is small. Paraphenylenediamine at one time had a few friends, but to my mind the use of this substance in the Rubber Industry is an outrage. Owing to its frightfully poisonous nature it has no place in the rubber factory.

The Advantages of Using Accelerators.

Now a few words with regard to the advantages of accelerators. First and foremost, of course, is the matter of decreased cure. Accelerators have been used chiefly in moulded goods, and of course the length of the cure is of enormous importance in this line of manufacture, because the factory output is determined purely and simply by the length of cure. So it is fortunate that accelerators are of most advantage in this particular class of work, where added equipment is expensive and sometimes cannot be installed. It is doubtless the savings effected in this respect which are largely responsible for the rapid advance in the use of accelerators in the United States. Take tyres: the output of a tyre factory is partially limited by its milling and calendering capacity, but chiefly by its moulding and curing capacity. If you cut the length of cure in half you come very near to increasing your output by one-third, so the chief advantage of accelerators is that of decrease of cure, and in that manner enabling you to turn out a larger output. The decrease in overhead and fixed charges is obvious.

A second advantage of accelerators is that they decrease the tendency to over-cure. This statement will be questioned probably. What I mean is that in the presence of an accelerator, notably "hexa" and the guanidines, an increase in the conditions of cure which would ordinarily result in an over-cure does not bring about a state of over-vulcanization. The presence of an accelerator, when used in its proper amounts, makes the compound less susceptible to over-vulcanization.

In the third place, and I think this statement will not be doubted, a properly vulcanized accelerator compound ages better than a properly vulcanized compound without an accelerator. By that I do not mean to say that an accelerated compound is fool-proof; but a compound containing an accelerator, if vulcanized correctly; that is to say, if precautions are taken to make sure that the compound is not over-vulcanized, ages better than a similar correctly vulcanized compound without the accelerator.

Precautions to Secure Ageing Qualities.

In closing I would like to offer, if I may, one or two suggestions as to the manner in which a manufacturer could proceed if he was desirous of using an accelerator but was somewhat afraid that his product would not act satisfactorily, or that he would run into serious difficulties of some kind or another. The great danger in using an accelerator is over-cure. An accelerated compound which may appear properly vulcanized need not necessarily be correctly vulcanized unless one is assured that a decrease in cure will result in an under-vulcanized compound. In other words, if one adds an accelerator one should start an experiment by working upwards from a condition of under-cure. An under-cure is very readily recognized of all; the difficulty lies in recognising the over-cure. Having got this state of under-cure, the cure should then be raised until what is ordinarily regarded as a good cure is obtained. By following the reaction in this manner the danger of over-cure is small. On the other hand, if an article is cured, and an examination shows it to be unsatisfactory merely from the standpoint of tensile, elongation and permanent set, one cannot be assured that a decreased cure will not result in just the same physical conditions, and one should take special precautions to preclude the possibility of over-vulcanization

The Accelerated Ageing Test.

I believe that last year Dr. Geer spoke to you about the accelerated ageing test which he has been using for eleven or twelve years. I do not know how popular the accelerated ageing test is in England, but I would heartily commend it to the attention of every manufacturer. The accelerated ageing test is not fool-proof, considerable judgment has to be used in interpreting the results obtained. One should always age, simultaneously with the sample under examination, a stock of essentially similar composition, the ageing qualities of which are accurately known. If operated in this manner, and if precautions are taken to ensure a reasonable flow of new air into the ageing oven, results of great value are obtained.

Personal Experience.

I have had actual experience with the accelerated ageing test for somewhat over ten years, and I frankly say that so dependent have I become upon this ageing test that I am very reluctant to pass any opinion on a cure without first subjecting the sample to the action of an elevated temperature. Dr. Geer uses 70 deg. C., I happened to start with 65 deg. C., and for no reason at all other than that it gives good results have stuck to it. It does not make much difference, I think, whether you use 65 or 70. The important thing is to age, simultaneously with the sample under examination, another sample of similar composition and of known ageing quality. This is very readily possible in the case of experimental samples that come

erator, it being merely necessary to age, simultaneously with the accelerated sample, a sample of the stock free from the accelerator, and compare results. If a manufacturer proceeds in this manner, I have no hesitation in saying that he can develop the use of accelerators successfully in a reasonably short period of time. I would certainly suggest that natural ageing tests — let us say, from four to six months, should always be employed. But in the course of six months a manufacturer should be in a position to tell with safety and surety that an accelerated compound will age, and will act satisfactorily. (Applause.)

THE DISCUSSION.

The chairman regretted that his knowledge of technical matters was so small that it was impossible for him to put questions. One point that struck him as a layman, however, was that the address appeared to have touched on exceedingly practical lines. He would set the ball rolling by asking when accelerators first came into use.

Dr. Weber said that it was his understanding that accelerators were first used on a commercial scale by the Diamond Rubber Company in 1906, and shortly afterwards thiocarbanilide was introduced either by the Diamond Company or the Goodrich Company, probably about 1908. Up to 1915 the number of concerns using accelerators was small, but from then on progress had been rapid.

Mr. Noah (International Rubber Co.) asked what accelerator could be used in a mixing that contained antimony sulphide.

Dr. Weber said it would be perfectly safe to use hexamethylene tetramine or triphenyl guanidine. It was stated by some manufacturers of antimony that accelerators should not be used in addition with the latter pigment, but the fault lay with the antimony and not with the accelerator.

Mr. Noah inquired whether triphenyl guanidine was active in the absence of zinc oxide.

Dr. Weber said he could not definitely answer that question. He thought it probable that the accelerator would be active in the absence of zinc oxide, but the activity would be increased when zinc oxide was added.

Dr. H. P. Stevens said that the lecture had been very interesting. He was pleased to see that Dr. Weber had not been able to get down to actual manufacturing procedure. In the past they had not heard much about that; they all seemed to fight shy of coming down to tintacks. With regard to scorching, he understood that was more likely to take place on large machines. Was that really so, or was it possible to have efficient cooling of the rollers? In this country many manufacturers showed a preference for smaller machines because they could be kept under control. He also asked whether Dr. Weber had had any experience with so-called super-accelerators. The difficulty which they found with them was that vulcanization set in spontaneously, causing the batch to be wasted, but these so-called super-accelerators had most remarkable properties, and it was possible to use 1 or 2 per cent. of sulphur and to get vulcanization at a very low temperature. Provided they met with no insuperable difficulty, they should come into wide use. Had the lecturer any experience of them?

Dr. Weber, referring to the question of scorching, said that theoretically the larger mills should be equally as efficient as the smaller ones, but in actual practice this was not found to be the case, and the danger of scorching on the large mill was much greater. In the United States they had a disagreeable temperature problem to contend with, and in the summer they were liable to have a midday temperature of 85 to 95 for weeks at a stretch. This was quite usual in July to have an average midday temperature of 89. In summer the question of keeping the mills cool was much greater, and the manufacturer who met with the most serious trouble was the one who employed large mills. With regard to the use of sulphur, it was well-known that the presence of an accelerator resulted in a decreased vulcanization co-efficient. Whereas the accepted co-efficient is 2.8 to 3, in the presence of organic accelerator co-efficients of less than 1 appear to be quite satisfactory. The trade tendency towards non-blooming compounds was diminishing in the States. Manufacturers found that non-blooming compounds were undesirable from a manufacturing standpoint and the tendency was for blooming compounds wherever possible. Dr. Weber then emphasised the danger of over-curing, when accelerators were present. In the early days, he said, over-curing was not recognised, and he wished he had the income on the capital that had been lost on that account. With regard to super-accelerators, he thought they were at present of purely laboratory interest. They certainly had big possibilities, but not with the present methods of manufacture.

Mr. S. J. Peachey, referring to aniline oil, said that his experience was that it was not used because of its acceleration properties, and he would like to hear whether it was a fact that it was used in the United States because of its softening qualities only.

Dr. Weber said that aniline oil was an accelerator of the vulcanizing process, although there was a danger of losing a proportion of the aniline oil added to the compound owing to its volatility and especially in highly compounded stocks, which require considerable mixing.

Mr. Peachey referred to the difference between aniline oil and paranitiosodimethylaniline and asked what were the relative activities of the two.

Dr. Weber said that while the question was difficult to answer accurately, he thought that the paranitiosodimethylaniline was at least four times as strong as aniline oil.

In answer to Mr. Fordyce Jones, the lecturer said that the whole philosophy of accelerators was directed towards increasing the output of the plant. Regarding the acceleration of reclaimed rubber, it was found that this material was not very susceptible to the action of accelerators. In the case of compounds containing reclaimed rubber, the acceleration observed was doubtless due to the action of the accelerator on the crude rubber, which was nearly always present to some extent, rather than on the reclaimed rubber. Regarding the present consumption of reclaimed rubber in the United States, while it was of course true that the tonnage consumption had decreased during the depression period, the ratio of ultilisation of crude and reclaimed rubber had decreased only slightly. Accurate statistics on that point were available from the published figures of the Rubber Association of America. Those statistics showed that in normal times for every pound of crude rubber used in the industry 0.7 lb. of reclaimed rubber was consumed. Owing to the fact that oil substitutes found very little application in compounding in the States, the rubber scrap available to the reclaimer was very well adapted for reclaiming and a thoroughly high grade reclaimed rubber was obtained. The American compounder had come to regard reclaimed rubber, not as a filler, but as fulfilling a definite function in the compound, and results were obtained by the use of reclaimed rubber which could not be obtained in any other way.

The chairman said that Dr. Weber had cheered him up somewhat by mentioning that there was a shortage of some sort in connection with rubber. (Laughter.) But unfortunately one swallow did not make a summer. He wondered whether Dr. Weber could give him the name of an accelerator which would accelerate the consumption of surplus rubber—that was the accelerator he wanted.

Mr. Fordyce Jones, proposing a vote of thanks to the lecturer, said it was very difficult for Britishers to express their appreciation in words, and he thought that he was only voicing the thoughts of the meeting by suggesting that Dr. Weber should take their appreciation without words. That Institution stood for the very thing that Dr. Weber was one of the first to fulfil. The lecturer had not only done a great thing for their Institution, but a great thing for the British Rubber Industry. America consumed 75 per cent. of the rubber consumption of the world, and they, as Britishers, wanted to feel that they were not competitors, but that they had the same ideals and wished to pull in the same path. While that was a very small meeting, he wished Dr. Weber to realise that he had addressed the whole British Rubber Industry, which was eagerly waiting to hear what he had said through the medium of the Trade press.

Mr. Rogers, seconding, said that he had listened to the paper with very great interest indeed. At the last Rubber Exhibition he had heard the paper by Dr. Geer on Ageing, and he was pleased to find that Dr. Weber followed on the same lines on the question of temperature.

The vote was carried by acclamation, and on the proposition of Dr. Stevens a similar vote was accorded Mr. Zorn for presiding.

The chairman, in reply, said that his impression of that meeting was that it was the most interesting of any spent at the Institution of Rubber Industry. 94

PLAINTIFF'S EXHIBIT No. 30

Application of Morris L. Weiss. Ser. No. 490,746. Filed Aug. 8, 1921. For Improvement in Accelerators for the Vulcanization of Rubber

Specification

To all whom it may concern:

Be It Known That I, Morris L. Weiss, a citizen of the United States and resident of the Borough of Brooklyn, County of Kings, State of New York, have invented certain new and useful improvements in—

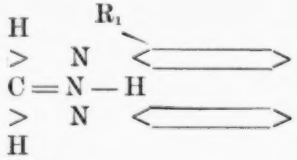
Accelerators for the Vulcanization of Rubber of which the following is a full, clear, concise and exact description:

The object of my invention is to produce a substance which will accelerate the vulcanization of rubber and similar substances through its catalytic action on the rubber and on the vulcanizing agents when used therewith, so that the rubber is cured or vulcanized more quickly and with a smaller amount of vulcanizing agents than heretofore have generally been used.

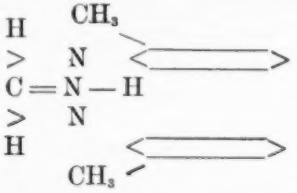
During my work relating to the production of guanidines, particularly diphenylguanidine, I discovered that certain substituted guanidines obtained from primary aromatic amines containing hydrocarbon residues comprising those termed hydrocarbon or alkyl groups in the ortho position, and produced from substituted aromatic thioureas containing alkyl groups in the ortho position relative to the nitrogen of the thiourea, have the beneficial and valuable action, when used as accelerators, of enabling rubber to be cured or vulcanized in a relatively shorter time than heretofore has been necessary in the usual vulcanizing operations under steam pressures and temperatures commonly used.

Furthermore, I have found that the accelerated action in the vulcanization of rubber is produced by comparatively small quantities of the accelerating compound, so that there is no undesirable loading or adulteration of the rubber compound, which is maintained in its original color and texture when completely vulcanized. In fact, the use of my improved accelerator improves the final quality and texture

of the rubber and also increases its durability, and it is less liable to air vulcanization and blooming. The class of chemical substances in which the improved accelerator constituting my invention is found may be represented by the following formula:



In this formula R_1 may represent any hydrocarbon or alkyl radical such as CH_3. This, of course, may be either in one phenyl group as indicated in the above formula, or in both phenyl groups, such as symmetrical di-ortho-tolyl guanidine represented by the formula—



The groups of aromatic amines referred to, as well as the thiourea derived therefrom, comprises the xqlidins, amino-cymenes, cumidins and napththyl amines.

The process of carrying out my invention which I at present deem preferable may be illustrated by the following example:

The rubber is compounded in the following proportions:

50		parts by weight of raw rubber
45	75	" of zinc oxide
3	5	" of sulphur
	.75	" of di-ortho-tolyl guanidine.

These are mixed together in any suitable way, such as by milling, and vulcanized or cured in the usual moulds or otherwise under a steam pressure of substantially 40 lbs. per square inch. This vulcanizing temperature should be continued until the compound is suitably vulcanized, which

requires from 10 to 20 minutes, depending on the amount or size of the articles being vulcanized.

I have found, however, that with lower steam pressure and consequent reduction of temperature vulcanization will also proceed to the desired point but requires a slightly greater period of time. Thus, it is obvious that the temperature may be reduced, if desired, with the consequent advantage of eliminating the possibility of the rubber being burned or overcured.

Having thus described this example of the invention and the method of using the same, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, etc., etc., indicated, for various changes may be made without departing from the essential features of my invention, as set forth in the accompanying claims.

What I claim and desire to protect by Letters Patent is:

1. The process of treating rubber or similar materials which comprises combining with the rubber compound an aryl substituted guanidine having an alkyl group in the ortho position.

2. The process of treating rubber or similar materials which comprises combining with the rubber compound an ortho-tolyl guanidine.

3. The process of treating rubber or similar materials which comprises combining with the rubber compound di-ortho-tolyl guanidine.

4. The process of treating rubber or similar materials which comprises combining with the rubber compound a substituted guanidine accelerator having an alkyl group in ortho position and derived from a primary aromatic amine.

5. The process of treating rubber or similar materials which comprises combining with the rubber compound a substituted guanidine accelerator having a methyl group in ortho position and derived from a primary aromatic amine.

6. The process of treating rubber or similar materials which comprises combining with the rubber compound a substituted guanidine accelerator derived from ortho-toluidin.

7. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and an aryl substituted guanidine accelerator having an alkyl group in ortho position.

8. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and an ortha-tolyl guanidine.

9. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and di-ortho-tolyl guanidine.

10. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and an oryl substituted guanidine accelerator having an alkyl group in ortho position.

11. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and an orthotolyl guanidine.

12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diortho-tolyl guanidine.

13. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and a substituted guanidine accelerator having an alkyl group in ortho position and derived from a primary aromatic amine.

14. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and a substituted guanidine accelerator having a methyl group in ortho position and derived from a primary aromatic amine.

15. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and a substituted guanidine accelerator derived from ortho-toluidin.

(Signed) Morris L. Weiss.

(Here follows Plaintiff's Exhibit No. 31, marked side folio page 100)

PLAINTIFF'S EXHIBIT NO. 21

100

A DICTIONARY OF APPLIED CHEMISTRY

BY

SIR EDWARD THORPE, C.B., LL.D., F.R.S.

Director of Scientific Considerations

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DEFENDANT'S EXHIBIT "A"

United States District Court, Southern District of New York

In Equity

DOVAN CHEMICAL CORPORATION, Plaintiff,

vs.

NATIONAL ANILINE & CHEMICAL COMPANY, INC., Defendant

On Patent No. 1,411,231, to M. L. Weiss

Affidavit of M. L. Weiss on Motion for Preliminary Injunction

STATE OF NEW YORK,
County of New York, ss:

Morris L. Weiss, being duly sworn, deposes and says as follows:

I am the Morris L. Weiss who has heretofore made an affidavit in this cause dated May 26, 1922. In addition to my former affidavit, I depose and say as follows:

When I entered the employ of the Republic Rubber Company at Youngstown, Ohio, on October 18, 1917, I was assigned to analytical work relating to the manufacture of rubber goods and among such analyses I was asked to analyze and test certain organic substances known as accelerators for use in vulcanization of rubber compounds. During my work on such substances during the spring of 1918, it occurred to me to try dis-ubstituted guanidines, particularly diphenylguanidine as an accelerator for rubber vulcanization. This occurred to me without any previous suggestion, direction, or information from anyone whomsoever as I had never previously known or heard of the use of diphenylguanidine as an accelerator in rubber vulcanization. I had, however, at that time, made some tests on triphenylguanidine as an accelerator for rubber, this substance having been prepared by me in the course of my work to ascertain its action in vulcanization as I had been informed that it had been used to some extent by the Republic

Rubber Company prior to my being employed there. In June, 1918, I took my vacation and went to New York and visited the New York Public Library at 42nd Street and Fifth Avenue, to look up various questions relating to accelerators, such as their poisonous nature and other questions. This was at the request of Mr. Monroe H. Daniels prior to my leaving on my vacation. Having had diphenylguanidine previously in mind I particularly noted reference to the same when looking for publications relating to triphenylguanidine, paraphenylenediamine, etc. As a result of this examination at the New York Public Library, I found very little literature on diphenylguanidine but found sufficient data to enable me to prepare a small quantity of diphenylguanidine, which I did during the month of September 1918. The quantity produced at that time was not sufficient to permit a test in a rubber compound. During my conversations with Mr. Daniels in the month of September 1918, I mentioned to him my tests of triphenylguanidine and advised him that I desired to also try diphenylguanidine to ascertain whether it would be a good accelerator, and told him that I was at that time trying to produce a sufficient quantity to test it in a rubber compound in the laboratory. At that time I did not have sufficient data to produce any considerable quantity of diphenylguanidine, and therefore, in January 1919, I visited the library of the Carnegie Institute at Pittsburgh, Pennsylvania, and went through the literature on this subject. As a result of this investigation I found descriptions of various processes for making diphenylguanidine by laboratory methods and upon my return to Youngstown, Ohio, about the middle of the same month, January 1919, I prepared sufficient diphenylguanidine and tested it soon thereafter in a rubber compound. During the month of February I continued tests on diphenylguanidine by mixing it with various rubber compounds, the results of which are shown in the book now in possession of the Republic Rubber Company at Youngstown, Ohio, known as the Chemical Laboratory X Book. The entries in this book were made in my own handwriting as concerns my personal experiments with and test of diphenylguanidine. Having found that the diphenylguanidine seemed to act as a good accelerator, I immediately started to develop a process by which it could be produced

cheaply in commercial quantities. This work continued until the end of the year 1919 in addition to my regular duties as head of the analytical department of the chemical laboratory, tests on diphenylguanidine as an accelerator also being conducted from time to time during that period. Early in the year 1920, I completed the process for manufacturing diphenylguanidine in commercial quantities and at a reasonably cheap price and on or about the 2nd day of March 1920, I submitted a report to the Republic Rubber Company, stating the results of my experiments and the results of my work in producing a process of manufacturing the accelerator. An exact copy of the original report is attached hereto, marked "Weiss Exhibit A" and is dated March 2, 1920.

During the latter part of February, I was advised that my services would not be required after the 15th of March, and, therefore during the first week in March I went to Akron, Ohio, and visited the factory of the Firestone Tire and Rubber Company with a view to obtaining a position with that company. At the factory of the Firestone Tire and Rubber Company, I met Mr. N. P. Shepard, who was the research chemist, and gave him the original copy of my report disclosing the process for the manufacture of diphenylguanidine similar to that in Weiss Exhibit A. Said Shepard expressed interest in the accelerator and process of making the same and asked a number of questions concerning my experience, but after leaving the factory, I was advised by him that there was no opportunity at the factory of the Firestone Tire and Rubber Company. During my conversation with Mr. Shepard, he stated to me that he would refer the matter to a Mr. Young, the chief chemist. A few days later said report was returned to me at Youngstown, by the Firestone Tire and Rubber Company by mail without any accompanying letter but a letter was later received stating there was no vacancy. I left the employ of the Republic Rubber Company, on or about the 15th day of March 1920 and came to New York to look for employment in that city. As stated in the bill of complaint and in my prior affidavit executed May 26, 1922. I then visited the office of the defendant, 21 Burling Slip and the office of Mr. Henry S. Doty and Mr. Van Lear Woodward and other chemical concerns in New York City. I have read the affi-

davits of Messrs. Henry S. Doty and Van Lear Woodward made in this case and aver that the statements made therein concerning the starting of the business relating to the manufacture of diphenylguanidine, its development and present condition, are true to the best of my knowledge, information, and belief. I would say, however, that during the fire which occurred at the Brooklyn factory in September, 1921, many of my notes and records were destroyed, said notes and records including those that I had made while with the Republic Rubber Company of Youngstown, Ohio.

I have read all of the eight answering affidavits submitted by the defendant in this cause. Regarding the affidavits of Corl H. Eaton and Carl H. Zieme both executed June 3, 1922, I would say that the statements made therein regarding the alleged early disclosure of diphenylguanidine as an accelerator by said Eaton to said Zieme are untrue to the best of my knowledge and belief and that the statement that said Eaton suggested to me that diphenylguanidine would be a better accelerator than triphenylguanidine because of its higher nitrogen content is wholly untrue and without foundation.

Said Eaton was employed by the Republic Rubber Company only as an analytical chemist on routine work during the latter part of the year 1918 and the first part of the year 1919 as it was the policy of the Republic Rubber Company to give newly employed chemists general analytical work only for the first year or so of their employment in order that their knowledge and capabilities could be determined before special or research or any other work was entrusted to them. Consequently, it was not until after the middle of the year 1919 that I may have had any conversation with said Eaton concerning accelerators for rubber vulcanization, particularly in view of the fact that I considered him not sufficiently familiar or experienced in the chemistry relating to rubber and organic synthesis to understand or do work in organic accelerators, as he had been previously employed as a chemist for the Youngstown Sheet & Tube Company. Up to the latter part of the year 1919, said Eaton was fully occupied with routine analytical work as were the three or four other analytical

chemists employed under me at that time. Furthermore all work carried on by the assistant chemists in my department was embodied in written reports which were sent to me and which I had copied in typewriting and submitted to the respective assistants for their signatures. These reports were always dated and one copy was sent by me to the chief chemist, at that time Mr. Monroe H. Daniels, and a carbon copy retained in my files in the analytical laboratory. I am, therefore, sure that said Eaton did not make any suggestion to me as he alleged, for if he had done so I should have immediately told him of my prior work on diphenylguanidine and would have advised him of my intention to continue the same.

The statement made by said Eaton that he actually used diphenylguanidine as a rubber accelerator during the month of January 1919 and at various times thereafter is also to the best of my knowledge and belief untrue. None of the analytical chemists were permitted to do compounding work in the chemical laboratory or elsewhere and all of the compounding relating to accelerators or other new ingredients of compounds were conducted by myself or under my direction.

Regarding Eaton's reference to his notebook I would say that he had no desk used solely by himself there being only one desk used by the three or four other assistants in the analytical laborartory, in which desk the notebooks provided by my department for recording data were kept. These notebooks were of the kind usually used by stenographers and large numbers of these books were thrown into the various drawers of this desk and practically discarded after having served their purpose. All valuable data which it was desired to preserve was copied from these books and embodied in the reports above referred to. As to the implication made by said Eaton that his notebook containing data relating to diphenylguanidine or any other records relating thereto were taken from his desk, I would say that there is absolutely no foundation therefor, particularly as it is obvious that the destruction or the taking of such notebooks from the desk would have made no difference because all valuable data relating thereto would have been recorded in the reports above mentioned.

I have read the affidavit of Monroe H. Daniels, executed June 10, 1922 and aver that the statements made therein regarding the relations between Carl H. Zieme and said Eaton are true to the best of my knowledge and belief and therefore consider it contrary to fact that said Eaton disclosed to said Zieme that he was working on the production of diphenylguanidine or that he proposed to use the same as a rubber accelerator. From my intimate knowledge of the work of the chemical laboratory I am positive that said Eaton never did any work on the production of diphenylguanidine during my connection with the Republic Rubber Company.

It is possible that said Zieme and said Eaton may have had some conversations regarding diphenylguanidine as an accelerator during the month of December 1919 or one year later than the alleged time. This seems particularly to be the fact in view of the absence of any written records of the Republic Rubber Company indicating such work and such work could not have been continued at all during the year 1919 without having come to the knowledge of Monroe H. Daniels or myself. Furthermore in the latter part of the year 1919 I personally told said Zieme that I had produced diphenylguanidine as an accelerator for rubber compounds, that I was working on a process for manufacturing the same in sufficient quantities for use in the factory and that I intended to use it in hose compounds he being superintendent of the hose departments. At that time said Zieme did not mention to me that anyone else connected with the Republic Rubber Company had been working with diphenylguanidine as an accelerator.

I have read the paragraph of the affidavit of Mr. Monroe H. Daniels dated June 10, 1922, concerning said Daniels' conversation with said Eaton after the meeting of the American Chemical Society in September 1919 and believe that said paragraph states the true fact and that the next succeeding paragraph relating to said Daniels' conversation with me states the fact in that regard because I distinctly remember that said Daniels told me that the paper read by said Kratz at said meeting confirmed our experience with diphenylguanidine as an accelerator and that we should continue our work on that substance and develop a commercial process if possible.

I have examined the photographic copies of the pages of the laboratory X-book No-. 2006, 2034 and 2042 attached to said Daniels' affidavit as "Daniels' Exhibit B" and recognize the same as being correct copies of the said pages of said book kept by me and recorded in my own handwriting. I also recognize the photostat copies of said pages and the additional pages 2010 and 2059, 2060, 2064, 2065, and 2066 as being copies of pages from said laboratory X-book, which copies are attached to the affidavit of said Corl H. Eaton the handwriting thereon being my own with the exception of the letters "C_6H_5 COOH", the figures "9-15-17", the word "magnesia" and the figures in the second ruled column. The references on these pages to diphenylguanidine, diffendo and other accelerators indicate compounds suggested by me and actually tested by vulcanizing the same which tests were made on or about the dates indicated by the figures at the bottom of the ruled columns. The earliest date mentioning diphenylguanidine as having been used is "2-10-19" on sheet No. 2034. The next earliest date is "2-21-19" on sheet No. 2036 but the latter date has an arrow below it pointing to "compare with X 2005 H". The latter sheet X 2005 having column H thereon, I understand from the affidavit of said Eaton was missing from the book and therefore could not be copied. I am at a loss to understand why this page should have been extracted from this book as I am positive that the same was in the book at the time I left the Republic Rubber Company and believe that the same was taken out by someone adversely disposed toward my interests. I certainly did not remove this or any other page from that book.

Said Eaton states that on page 2034 the date "9-10-19" was apparently changed to "2-10-19." If any change were made as regards these figures the change was from a "1" to a "2" instead of from a "9" to a "2", January being the next preceding month to February. If any such change were made, it was made on February 10, 1919 and not subsequently thereto as seems to be implied by the statement of the said Eaton. Regarding the last paragraph of said Eaton affidavit, I would state that the same is incorrect and does not state the fact. Work was carried on by me to develop a process of producing diphenylguanidine in com-

mercial quantities at various times during the entire year of 1919 and a large number of experiments were made to test the various methods described in the literature and to develop other methods which might be more efficient. Toward the end of the year 1919 a new method was developed and tested on a semi-commercial scale and this is substantially the process disclosed in my application Serial No. 482,143 filed July 2, 1921, for Process of Making Diphenylguanidine as an Accelerator for Rubber Vulcanization. A certified copy of said application is submitted herewith marked "Weiss Exhibit B". This process is substantially the same as that set forth in "Weiss Exhibit A" of March 2, 1920 and which indicates the very extensive work made necessary to develop the process, it being obvious that such work could not have been started and completed between November 1919 and the latter part of February 1920 in addition to my other duties made necessary by virtue of my position as the head of the analytical laboratory.

Regarding the affidavit of Norman A. Shepard dated June 5, 1922 and submitted by the defendant it is true that I did make application for employment at the Firestone Tire & Rubber Company, Akron, Ohio, about March 3, 1920 and I talked with said Shepard at that time. I did not make any statement or assertion to have originated the use of diphenylguanidine as an accelerator because I considered that the main difficulty in its use was that of finding a process to produce the material in substantial practical quantities and I emphasized that fact rather than the fact of my having originated its use. My reference to the article by Kratz was simply by way of corroboration of my work as to the activity of diphenylguanidine as an accelerator, as shown by my notes made on the application blank, copy of which is attached to said Shepard affidavit. Furthermore I was not confident that any part of a group of organic compounds, some of which had been used as accelerators for rubber, could be patented as such because I had been so informed prior to my leaving the Republic Rubber Company when discussing the subject with a party adversely disposed toward my interest. This impression was corrected by patent counsel for the Dovan Chemical Corporation when considering the applications

for the Process of Making Diphenylguanidine above referred to as "Weiss Exhibit B". I had always considered that I was the originator of diphenylguanidine as an accelerator for rubber and had never heard of any consideration whatever of it by others until my talk with Monroe H. Daniels after his return from Philadelphia in September 1919.

I have read the affidavit of John Young executed June 8, 1922 and would state that any recollection which said Young may have had relative to my reference to the Kratz paper is apparently based only upon an examination of the written application in which I mentioned the paper for the same reasons and without in any way giving credit to said Kratz for having discovered the advantages of diphenylguanidine as a rubber accelerator. I had no conversation whatever with Mr. Young.

I have also read the affidavit of Alfred L. Loebenberg executed June 8, 1922 and state that the reference made to Dr. Kratz during my conversation with said Loebenberg was for the same reasons above mentioned in connection with the Shepard affidavit and I in no way conveyed to him any statement that I did not consider myself the originator of diphenylguanidine as an accelerator.

Regarding the letter under date of April 13, 1920, mentioned in the Loebenberg affidavit I would say that I do not recollect ever having received such a letter but I did return to the office of the National Aniline & Chemical Company about a week after my first visit and was simply requested to fill out another application blank without seeing Mr. Loebenberg or anyone whom I had before known. I filled out the second application but never thereafter received any reply to the same.

Morris L. Weiss.

Sworn to and subscribed before me this 12th day of June 1922. Walter S. Jones, Notary Public, New York Co. (Seal.)

8:21

Dept Ex 22c

NATIONAL ANILINE & CHEMICAL CO., INC. 1/3/23 Ex 14

Ex 13

10/17/23 HC

APPLICATION FOR EMPLOYMENT 6-14-23

DATE 10 Oct 2-1918

NAME M. J. Lewis — POSITION DESIRED Research Chemist — APPLICATION NUMBER 4629

DATE AVAILABLE Immediately — LOCATION DESIRED Jersey City — SALARY DESIRED $2400 a year

TEMPORARY OR PERMANENT Permanent — IF CONTRACT REQUIRED Renewable — MINIMUM ACCEPTABLE $2400 a year

PRESENT ADDRESS 614 W 138th St N.Y.C. — PHONE 3334 Audubon

PERMANENT ADDRESS — AGE AT DATE OF APPLICATION 28

PREVIOUS EMPLOYMENT

DATE	POSITIONS AND DUTIES	COMPANY NAME AND BUSINESS	ADDRESS
1913-1918	Asst Research Chemist	Herman Frasch Laboratory	50th St & 10th Ave City
1918-1922	Research Chemist	Republic Rubber Co	Youngstown, Ohio

SCHOOLS ATTENDED	DATES FROM	DATES TO	COURSES AND STUDIES	DEGREE AND DATE
Rogers Institute	1908	1913	Chemical	Diploma 1913
Polytechnic Institute	1913	1916	College Chemical	B.S. in Chem 1916

PERSONAL REFERENCES	ADDRESS	OCCUPATION	NATURE AND EXTENT OF ACQUAINTANCE
Dr. S. Grunwald	Harriman Research Lab. Harriman, N.Y.	Research Chemist	Has employed me since graduation
H. L. Fisher	Harriman Research Lab. Harriman, N.Y.	Research Chemist	Associate at Harriman
Wm. M. Daniels	2109 Elm St Youngstown, O.	Asst Chemist	Employed me as Asst Chemist at Youngstown, O.

PUBLICATIONS, INVENTIONS, PROFESSIONAL ACTIVITIES "The Fate of Diphenylcarbazone in Titrations" S. Grunwald & M. L. Weiss Journ. of Biological Chem July 1917

LANGUAGES SPOKEN OTHER THAN ENGLISH German and French

MILITARY AFFILIATIONS AND ACTIVITIES (PAST AND PRESENT) None

NATIONALITY American — DATE OF FIRST PAPERS — DATE OF FINAL PAPERS

MARRIED OR SINGLE married — DEPENDENTS

PHYSICAL CONDITION Good

PHYSICAL DISABILITIES, ACCIDENTS, FAILURES None

HEIGHT 5 ft 9 inch — WEIGHT 170 lbs — ENDURANCE good — VITALITY good

114

Defendant's Exhibit B (Page 1)

8:23'

Work at Republic Tire + Rubber Co -
Development + manufacture + application
of accelerators - Amline, TCA,
diphenylguanidine triphenylguanidine
aldehyde &c — (also Nitroso Duals)

1 - Amline = .8 Thio
1 - Diphenylguanidine = 4 Thio
1 - " - 4 Triphenyl - (Ethanol)
1 - Diphenylguanidine = 1½ Thiocarbanilide

Ac Knafy

Defendant's Exhibit B (Page 2)

Ex. No. 2
U. S. Dist. Court,
S. D. of N. Y. 74-13

Dfts Ex C
10/19/45

FIRESTONE TIRE & RUBBER COMPANY
AKRON, OHIO

APPLICATION

No.

All information given in this Application will be treated as confidential matter by the company. By carefully and freely answering EACH of the questions on this application you will assist us in determining whether any personal trait or fact disqualifies you for service. It is desired that no space be left blank. If any question does not apply to you, so state. Please write in the applicant's own handwriting.

Name of applicant M L Meiss Date Mch 7 1916

Present Address 1196 Donaldson Ave Youngstown Ohio Phone No

Home Address New York City

Have you previously filed application with us? No Physical defects, if any None

The company requires applicants to pass a physical examination by its examining physician before they are accepted as employees.

Month	Day	Year	AGE Years	AGE Months	PLACE OF BIRTH	CITY	STATE
June	8th	1887	33	2			Russia

HEIGHT	WEIGHT	LINEAGE	Are you a Citizen of the United States?	If Not a Citizen, State When
5 ft 2 inches	118 lbs	English, Irish, French, Hebrew, German, Etc. 6	Yes	Mch 15th 1914

	FATHER	MOTHER	PLACE OF BIRTH	FATHER	MOTHER
	Hebrew	Hebrew		Russia	Russia

	Single	Married	Divorced	Number of Children	Number of Other Dependents	Relationship of Dependents
				None	None	

RELATIONSHIP	NAME	ADDRESS
Brother	A M Meiss	1727 Park Pl Brooklyn N Y

LIFE	HEALTH	ACCIDENT	PHOTOGRAPH	Whenever possible attach to this Photograph of yourself. If you do not, please enclose one in passage
$1000				

Of whom, among those connected with the Company, are you acquainted?

Mr. Heller, Compounding chemist, Mechanical goods Dept

EDUCATION

SCHOOL OR COLLEGE	ATTENDED From Year	ATTENDED To Year	COURSE OF STUDY	PROFICIENCY
Cooper Institute N Y C	1905	1912	Technical Chemistry	Good
Pratt Institute Brooklyn N Y	1913	1916	College course	

GIVE ANY ADDITIONAL INFORMATION REGARDING EDUCATION

I have also taken a course in physiological chemistry at Columbia University New York City

Defendant's Exhibit C (Page 1) 116

BUSINESS EXPERIENCE REFERENCES

EMPLOYER (Give full Name of Company or Firm)	CITY AND STATE	KIND OF BUSINESS	TIME EMPLOYED From Mo. Yr. To Mo. Yr.	POSITION YOU HELD	Salary or Wages	WHY DID YOU LEAVE?	CITY NUMBER OF BODY AND BOY UNDER WHOM YOU WORKED	HIS PRESENT STREET, CITY AND STATE ADDRESS	HIS PRESENT BUSINESS OR POSITION
1 Harriman Research Lab & J.C.	New York	Research Laboratory	Jan 1917 Feb 1917	Research Chemist	154	Suffered pay	Dr. J. Brannan	Roosevelt Hosp 59th St & 9th Ave N.Y.C.	Regional Chemist
2 Butterworth Judson Co	Newark N.J.	Manufacturing Chemists	Feb 1917	Research Chemist	154	Left Hamilton	Dr. A. L. Hamilton, M.D. Dr. H.H. Daniels	123 Rubber Co Youngstown Ohio	Asst. Chemist
3 Republic Rubber Co	Youngstown Ohio	Rubber Goods	Feb 1917	Asst. Research Chemist	$2.00			Elm St Youngstown Ohio	Asst. Chemist
4									
5									
6									
7									
Present Employer									

May we refer to your present employer? _____

BUSINESS REFERENCES OTHER THAN FORMER EMPLOYERS

NAME	ADDRESS	BUSINESS OR OFFICIAL POSITION	STATE PERSONAL RELATION
Dr. K. Sverge Falk	Harriman Research Lab & J.C.	Research Chemist	—
Dr. E.M. Fowler	" " " "	" "	"
Dr. L.J. Curtman	College of the City of New York	Asst. Professor of Chem.	—
Jno. A. Brannan	The Bryant Press & J.C.	Owner	Brother-in-law

State fully the lines of work in which you are proficient, your qualifications therein and your preference:

At the Harriman Research Laboratory I have been working in Biochemical research. I have done all the analytical work and a good deal of organic problems connected with the research problems. My name appears as collaborator on a paper published in the Journal of Biological Chem. for July 1917.

At the Butterworth Judson Co I worked on the commercial synthesis purification and methods of analysis of accelerator ingredients.

At the Republic Rubber Co I have developed a process for the manufacture of Carbamate, which is being worked successfully now. I have also developed a process for the manufacture of Thiocarbanilide which is worked successfully now in preference to their old process. By this process a 98% pure product is obtained without recourse to recrystallization. I have lately developed a process for the commercial production of Aldehyde Ammonia. The value of this product as an accelerator has been discussed by Dr. Keaty at the last Philadelphia meeting of the Am. Chem. Soc. and tests made on a basis he has shown that .05% of this product is equivalent to 1.0% of Amiline. This product is not being produced now as all development work has been stopped. However I prepared enough of it on a semi-commercial scale to test it out in the laboratory and plants. The laboratory tests show that one part of the product is equivalent to 4 parts of Thiocarbanilide and 10 parts of Tetramethyl Thiuram. It is a pure crystalline compound more hygroscopic and volatile and more poisonous. The cost of this product will be 3.50 to 4.00 cents a pound less than Thiocarbanilide. I did not get a chance to try it in the factory.

Salary Desired $ 250 per month — Least Salary Considered $ 200

The Space below to be Filled out by a representative of the Company

Recommended for _____ Department

At Salary of $ _____ per _____ Date Employed _____

Interviewed by _____ ; _____ ; Date _____

Interviewed by _____ ; _____ ; Date _____

Remarks: _____

Defendant's Exhibit C (Page 2) 117

Defendant's Exhibit "E."

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The Action of Certain Organic Accelerators in the Vulcanization of Rubber

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By C. D. Kratz, A. H. Flower and Cole Coolidge

[Reprinted from the Journal of Industrial and Engineering Chemistry, Vol. 12, No. 4, page 317, April, 1920.]

THE ACTION OF CERTAIN ORGANIC ACCELERATORS IN THE VULCANIZATION OF RUBBER[1]

By G. D. Kratz, A. H. Flower and Cole Coolidge

RESEARCH LABORATORIES, THE FALLS RUBBER COMPANY, CUYAHOGA FALLS, OHIO

Since the introduction of the use of organic substances to assist in, or to accelerate, the vulcanization of rubber, there has been remarkably little added to the literature upon the subject. Furthermore, what has been written has been confined largely to reviews of a general nature. Although King,[2] Peachey,[3] Twiss,[4] Spence,[5] and others[6] have contributed to this subject, the majority of investigators have remained reticent, despite the fact that the patent files are replete with information.

The present paper records a portion of the results procured in an attempt to obtain further information in regard to the action of certain organic substances in accelerating the vulcanization reaction. Throughout this work we have chosen to employ only substances which have previously been cited by others and whose definite chemical composition permits comparison with homologs or other closely related compounds. The activities of the substances from a practical standpoint were considered of secondary importance. Further, while we most assuredly recognize that the vulcanization reaction is, essentially, a catalytic one, we have chosen to employ the term "accelerator" rather than "catalyst," when referring to the organic substances in question. This distinction is deemed necessary to avoid misunderstanding, and to discriminate between catalysis as it is generally understood and as it must be applied to the vulcanization of rubber. In this regard, it is necessary to take into consideration the fact that a large number of the organic substances used to accelerate the vulcanization of rubber de-

[1] Presented before the Rubber Division at the 8th Meeting of the American Chemical Society, Philadelphia, Pa., September 2 to 6, 1919.

[2] *Met & Chem. Eng.*, 15 (1916), 231; 18 (1918), 246.

[3] *India Rubber J.*, 52 (1916), 603; *J. Soc. Chem. Ind.*, 36 (1917), 321; 36 (1917), 434, 950.

[4] *J. Soc. Chem. Ind.*, 36 (1917), 783.

[5] THIS JOURNAL, 10 (1918), 115.

[6] *Gummi Ztg.*, 29 (1915), 425; 30 (1916), 303; *India Rubber World*, 55 (1917), 190; *Caoutchouc et gutta-percha*, 15 (1918), 9637; *Rubber Age*, 3 (1918), 78.

compose below the temperatures at which vulcanization is ordinarily effected, and that many of them show a tendency to combine with the sulfur under vulcanizing conditions. Again, as most of the rubber mixtures in actual use contain mineral substances, the possibility of a reaction of these substances with the organic accelerators involving the alteration or decomposition of the latter, is far from remote. In fact, even before the general use of synthetic organic substances as accelerators, Esch[1] found it necessary to employ calcium and magnesium oxides with certain albuminous bodies in order to obtain the desired results. Likewise, Peachey[2] has noted a marked increase in the activity of *p*-nitrosodimethylaniline when used in conjunction with magnesia. Litharge was found to diminish the effectiveness of this accelerator.

Although we are confident that the use of organic substances as accelerators was practiced in the factories of this country long before the first patent on the subject was taken out abroad, the predominance of the early patents was undoubtedly German. In fact, the latter people, with their thoroughness and the realization of the possibilities in the subject, attempted to restrict the use of all nitrogenous substances by the use of such generalities as are found in one of Bayer and Company's patents.[3] That few, if any, applications for license to use these patents were made during the war is an indication of our priority in this field.

The first German patents upon accelerators appeared almost coincidentally with certain patents for the preparation of synthetic rubber, when it was found that this substance was abnormally slow in its reaction with sulfur. In this connection, Bayer and Company found that piperidine or its homologs[4] and the piperidine salt of piperidyl-dithiocarbamic acid[5] effected a marked acceleration in the vulcanization of Kondakow's rubber,[6] and, subsequently, they extended their claims to cover natural rubber. Prior to the above Bayer patents, however, a patent was issued to Wo. and Walther Ostwald[7] for the treatment of rubber, gutta-percha, and the like, with pyridine, quinoline, dimethylaniline, etc., in order to prevent

[1] D. R. P. 273,482 (1912).
[2] *J. Soc. Chem. Ind.*, 36 (1917), 424.
[3] D. R. P. 280,198 (1914).
[4] D. R. P. 266,680, 266,618 (1912); 263,387, 265,221 (1913).
[5] D. R. P. 266,619 (1913); U. S. Patent 1,126,469 (1915).
[6] *J. prakt. Chem.*, 64 (1901), 109.
[7] D. R. P. 221,310 (1908).

its becoming hard and fragile. It is most remarkable that in the course of this work the Ostwalds failed to note the action of certain salts of these and other closely related substances in accelerating the vulcanization of the rubber, even though the parent substances themselves possess little, if any, action.

Immediately following the patents for the use of piperidine and its derivatives appeared a variety of specifications covering the use of dimethylamine,[1] aldehyde ammonia, tetra- and hexamethylenediamines, *p*-phenylenediamine, and naphthylenediamines;[2] the formaldehyde condensation products of aniline and its homologs;[3] the guanidines;[4] naphthylamine;[5] and a large number of other amino-compounds, or nitrogenous substances, all of which have been mentioned previously by King, Peachey, Twiss, Spence, or Ditmar, and include such substances as quinoline and its salts, the quaternary ammonium bases, urea and thiourea derivatives, and a host of others. In their patents, Bayer and Company cover the urea and thiourea derivatives of saturated aliphatic amines, both open and closed carbon chains, which are saturated methylene open-carbon chain bases. The term "methylene base" is held to be generic to those bases which are saturated bases as distinguished from unsaturated bases as aniline. Suffice to say, that both aniline and diphenylthiourea were employed in this country long before the appearance of any of the above specifications.[6]

Although not specified in some of the foregoing patents, many of these were drawn upon the assumption that the activities of the various substances depended largely upon their nitrogenous nature and the basicity of the substances in question.

In view of the well-known effect of such inorganic bases as caustic soda or potash upon the vulcanization of rubber, the opinion that the basicity of certain substances is closely connected with their action as accelerators has found quite a few adherents. Among

[1] D. R. P. 269,513; French Patent 464,533.
[2] D. R. P. 280,198 (1914); U. S. Patent 1,149,580 (1915).
[3] British Patent 7,370 (1914).
[4] British Patent 17,760 (1914).
[5] U. S. Patent 1,296,469 (1919).
[6] In this connection it is interesting to note that in this country attention was directed to the use of urea as an accelerator before the appearance of these or any other patents upon urea or the thioureas. This is said to have been the result of observations made upon certain African rubbers, reputed to have been coagulated with human urine, and which were found to vulcanize with more than average rapidity.

these is Twiss,[1] who believes that both the organic and inorganic accelerators, all of basic nature, exert their influence in a similar manner. According to Twiss, the more powerful action of the organic bases is due to their greater solubility in the rubber, a principle which he has applied in preparing very active accelerators by the use of an organic liquid which would be soluble in the rubber and also act as a solvent for alkali. In a subsequent patent[2] he has still further extended this view to include such materials as solutions of sodium and potassium in aniline, the action of which would be difficult indeed to classify if essential differences are held to exist between the action of organic and inorganic accelerators. Peachey,[3] however, in his patent upon *p*-nitrosodimethylaniline, has taken another view, and attributes the activity of this substance, primarily, to the presence of the nitroso group. Subsequently, Peachey[4] has also expressed the opinion that, while the dissociation constant of 1×10^{-5}, referred to in the Bayer patents, does actually form a dividing line between accelerating and non-accelerating bases, there are other classes of accelerators (as *p*-nitrosodimethylaniline) which are not basic, or but slightly so. Further, in order to emphasize not only the effect of certain groups, but also the position of these groups in the molecule, Peachey has cited the nitroso bases as powerful accelerators, and pointed out that the isomeric nitrosamines, in which the nitroso group is not in direct combination with the nucleus are inert.

Likewise, Spence has mentioned that the activity of certain substances which contain groups in the para position are more active than the isomeric substances, in which the groups are in the ortho, or meta position, and has cited the relative activities of *p*-phenetidine and *o*-phenetidine as an example. He has also called attention to the increase effected in the activity of substances as accelerators by the introduction of other groups into the nucleus. As a case in point, he has made reference to the increase in the activity of diphenylthiourea when it is converted into tetramethyldiaminodiphenylthiourea. While there is no doubt that these differences exist as

[1] *J. Soc. Chem. Ind.*, 36 (1917), 782; British Patent 110,059 (1916).
[2] British Patent 124,276 (1919).
[3] British Patent 4,243 (1914).
[4] *J. Soc. Chem. Ind.*, 36 (1917), 950.

expressed by Peachey and Spence, it is to be regretted that no figures were given by either of them by which the relative activities of the various substances might be recorded.

Our own experience, a portion of which is embodied in the experimental part of this paper, in the main confirms the results of Peachey and Spence; and in fact, in many ways, permits of their amplifications. Not only have we found certain groups, and the position of these groups in the primary nucleus, to have a marked effect upon the activity of the substance under investigation, but we have found that if the effect produced by one or more groups is to be considered on a strictly comparable basis, the size (molecular weight) of the parent substance must also be taken into account. On the other hand, we are equally well convinced that with many substances it is possible to place too great stress upon the presence of certain groups and their position in the nucleus. It would appear that the effect produced by the different groups is largely determined by their behavior and ultimate condition as the original substance undergoes decomposition or chemical change, and that the activity of substances not originally basic is due to their conversion into basic substances during vulcanization.

For example, in our preliminary experiments we found that urea was slightly more active than thiourea. Thiourea, in turn, was more active than monophenylthiourea, and the latter more active than diphenylthiourea. The same was true in the case of the guanidines, both monophenylguanidine and diphenylguanidine being found more active than triphenylguanidine, although the conditions of our experiment did not permit of a differentiation between the two substances first mentioned. In the case of the thiourea, the natural inferences would be that the activity of the parent substance depended largely upon the presence of the NH_2 groups, with a consequent diminution in the effect produced as phenyl replaces hydrogen. In the case of the guanidines, the great difference in activities of mono- and diphenylguanidines, when compared with that of triphenylguanidine, may be attributed to the fact that in the latter substance the phenyl group has replaced imido rather than amido hydrogen.

Again, when we made a comparison between a cyclic

monamine and diamine, we found the latter, in accordance with the now general understanding, to be much more active than the former, if the groups are in the para position. On the formation of the anhydro-formaldehyde condensation products of these substances, however, although the activities of each were increased by the substitution of methylene groups for the hydrogen of the amino groups in the original substances, this increase in the case of the monoamine was much less than that produced by the introduction of a second amino group into the original nucleus. Although the two types of compounds are not isomeric, this is in line with Peachey's statement as to the effect produced when groups are introduced into a side-chain rather than the original nucleus.

In our subsequent and more extensive experiments, wherein we employed aniline as a basis of comparison, we found that the replacement of the amino group in aniline by hydroxyl actually decreased the rate of vulcanization to less than that of the control mixture which contained no accelerator. The introduction of a second hydroxyl group in the para position was found to cause a still greater retardation in the rate of reaction. In fact, when allowance was made for the difference in the molecular weights of the two substances, the anti-accelerating effect of hydroquinone was found to be just twice that of phenol. The difference between the effect of one amino group and two amino groups in the para position has already been mentioned, and here again, after having corrected for the molecular weights of the two substances, *p*-phenylenediamine was found to be almost exactly twice as active as aniline. When we employed *p*-amidophenol, however, in order to obtain an amino group and an hydroxyl group in the para position to each other, our results were not strictly in accordance with those of Peachey and Spence, who found that this substance was without action or but mildly active. On the contrary, we found *p*-amidophenol to be more active than aniline. The inference from our results would be that although the effect of the (OH) group is that of a retardant, its position in the nucleus, and its subsequent influence upon the decomposition of the nucleus during vulcanization, are of less importance than the effect produced by the stronger and positive (NH_2) group.

It is not our purpose, however, to attribute the action of certain substances as accelerators entirely

to the inclusion and position of certain groups in the primary nucleus. Rather, as has been said, we have been led to the conclusion that the great majority of organic accelerators owe their activity to their decomposition products, when this decomposition takes place in the presence of sulfur and under vulcanizing conditions. This corresponds very closely with Spence's third class of accelerators, which he believes may be inactive in themselves, but which, at the temperature of vulcanization, either alone or in the presence of other substances, may break down into a substance, or substances, having the properties of powerful catalysts. He has mentioned diphenylthiourea as an example of this type.

In the final experiment recorded in this paper, we have worked along these lines with aniline as a standard and have compared its activity with that of other substances into which it can be converted, or from which it can be derived by decomposition under vulcanizing conditions. The following reaction suffices to explain our method:

$$C_6H_5NH_2 + C_6H_5N{:}C{:}S \rightleftharpoons \begin{matrix} C_6H_5NH \\ C_6H_5NH \end{matrix}\!\!>C : S \quad (1)$$

That such a reaction, from right to left, actually takes place was indicated when we found that a mixture vulcanized with the assistance of a certain definite amount of diphenylthiourea had the same sulfur coefficient as that of a similar mixture, vulcanized under the same conditions, to which had been added aniline and phenyl mustard oil, in accordance with the amounts required by Equation 1. Similar sulfur coefficients also resulted for two mixtures, one of which was vulcanized with the assistance of triphenylguanidine and the other with quantities of diphenylthiourea and aniline, in accordance with Equation 2.

$$\begin{matrix} C_6H_5NH \\ C_6H_5NH \end{matrix}\!\!>C : S + C_6H_5NH_2 \rightleftharpoons \begin{matrix} C_6H_5NH \\ C_6H_5NH \end{matrix}\!\!>C : N.C_6H_5 + H_2S \quad (2)$$

The above reaction, likewise, takes place from right to left. The diphenylthiourea and aniline formed, however, evidently undergo further decomposition

with the formation of two molecules of aniline and one molecule of phenyl mustard oil.

Our interpretation of these results led us to the conclusion that both diphenylthiourea and triphenylguanidine owe their powers of acceleration to their tendency to decompose with the formation of aniline. On the other hand, and in view of our results as a whole and particularly those obtained with urea and thiourea, we certainly do not feel warranted in ascribing to aniline alone those properties which Spence has termed the "active principle." Rather, we are inclined to regard aniline as one of the simpler substances that contains a group which, under vulcanizing conditions and temperatures, functions as a sulfur carrier.

To elaborate upon the action of accelerators beyond this point, however, is hardly warranted from the results obtained. Moreover, further discussion must, necessarily, involve the theory of vulcanization in its entirety, which is not our intention in this communication.

We have shown that under vulcanizing conditions and temperatures, certain accelerators decompose or suffer degradation to simpler substances which are responsible for the acceleration effected. The decomposition of diphenylthiourea to aniline is an example. Such being the case, similar decompositions would appear possible with other substances. This decomposition having been effected, the action of the decomposition or alteration products is most conveniently interpreted on the basis of a change in the valency of the nitrogen in active groups from 3 to 5.

It is not to be understood, however, that we believe aniline as such is, necessarily and quantitatively, formed by the decomposition of diphenylthiourea under vulcanizing conditions. Further, the various complexes which we have postulated for aniline, *p*-phenylenediamine, etc., serve to account only for the relationship noted between the activity of the substance in question and its nitrogen content. Theoretical deductions of a general nature are not at present possible, as results obtained by Erdmann[1] and Ostromyslenskii[2] indicate that the active sulfur may take the form of a polysulfide and may even not be attached to nitrogen. However, for the purpose of interpretation, rather than deduction, and with aniline as an example, under the conditions and tempera-

[1] *Ann.*, **362** (1908), 133.
[2] A. H. King, *Met. & Chem. Eng.*, **15** (1916), 245.

tures at which vulcanization takes place, we postulate the existence of the following complex:

$$C_6H_5 - \overset{\overset{S}{\|}}{N} = H_2$$

As this complex would not be stable, except under the conditions and temperatures at which vulcanization is effected, it would function as a catalytic sulfur carrier, releasing its sulfur in an active form, which would combine with the rubber more readily than the sulfur originally included in the mixture. Its catalytic action would depend upon its ability to maintain an equilibrium between the active and inactive sulfur.

The above is in strict accord with our results for the relative activity of aniline and *p*-phenylenediamine. The hypothetical complex for the latter substance would include 2 pentavalent nitrogen atoms, or active groups, as below:

$$H_2 = \overset{\overset{S}{\|}}{N}.C_6H_4.\overset{\overset{S}{\|}}{N} = H_2$$

Thus, when the effect of molecularly equivalent quantities of aniline and *p*-phenylenediamine are compared, the latter should be just twice as active as the former. This was actually found to be the case. From this it is also possible to explain why Spence found tetramethyldiaminodiphenylthiourea so much more active than diphenylthiourea; the former substance would probably decompose into 2 molecules of dimethyl-*p*-phenylenediamine with just twice the number of active groups found in the latter. Further, we venture to predict that the activity of one molecular part of tetramethyldiaminodiphenylthiourea is exactly equal to that of 2 equimolecular parts of dimethyl-*p*-phenylenediamine,[1] and less than that of 2 equimolecular parts of *p*-phenylenediamine. The difference in the basicities of the last two substances accounts for their relative activities.

[1] It is interesting to note that Eaton, Grantham and Day (Dept. of Agr. Fed. Malay States, *Bulletin* 27 (1918), (319) found dimethyl-*p*-phenylenediamine hydrochloride to exert a marked retarding influence upon the vulcanization of a fast curing rubber. In this case, then, the nitrogen of the amino group is already pentavalent, and could not act as a sulfur carrier; it has already been shown that acid groups act as retardants.

In this connection, it should also be pointed out that although dimethyl-*p*-phenylenediamine is more active than aniline, dimethylaniline is practically inert.

$$\begin{matrix}(CH_3)_2N.C_6H_4.NH \\ | \\ C:S \\ | \\ (CH_3)_2N.C_6H_4.NH\end{matrix} \longrightarrow 2\left\{(CH_3)_2N.C_6H_4.\overset{\overset{S}{\|}}{N} = H_2\right\} \quad (3)$$

The latter observation is made in the light of our results with the ureas and guanidines. While our results with these substances are subject to the same general interpretation as the preceding, we found with them that the replacement of the hydrogen by phenyl in the active groups decreased the activity of the substance in question. It is possible that the substitution of larger groups for the hydrogen attached to the active nitrogen would cause the group to become inactive, due to steric hindrance precluding the formation of pentavalent nitrogen. Peachey's observation of the inactivity of the nitrosamine isomeric with *p*-nitrosodimethylaniline may be subject to this interpretation.

In view of this, our results with the anhydroformaldehyde condensation products of aromatic amines are more difficult to interpret, as the substitution of methylene for hydrogen increased the activity. In this instance, however, there will be two double bonds when nitrogen becomes pentavalent:

$$C_6H_4.\overset{\overset{S}{\|}}{N} = C : H_2$$

A complex of this type would be even more unstable, and more active, than that postulated for aniline.[1]

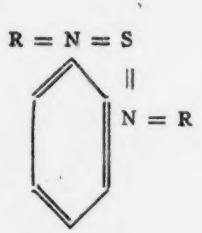
Lastly, in light of the readiness with which sulfur passes from the di- to the tetra- or hexavalent state, it is possible to adapt the former principles to account

[1] In the paper by C. W. Bedford and W. Scott, read immediately after the above, the following explanation was offered for the behavior of this substance. According to the above authors, under vulcanizing conditions and temperature, the following reactions take place:

$$2[C_6H_5N.CH_2] \longrightarrow C_6H_5.N\begin{matrix}CH_2\\ \\ CH_2\end{matrix}>N.C_6H_5 + 4S \longrightarrow$$

$$CH_2 + H_2S + (C_6H_5NH)_2C:S$$

We have already shown that diphenylthiourea probably decomposes into aniline and phenyl mustard oil. Further, we have shown that when compared on equal weights the activities of anhydroformaldehyde aniline and diphenylthiourea are approximately the same. As the molecular weight of diphenylthiourea is over twice that of anhydro-formaldehyde aniline, and as two molecules of the latter and one molecule of the former would each decompose into one molecule of aniline, a comparison with equal weight of the two substances should show anhydro-formaldehyde aniline to be slightly more active than diphenylthiourea. This is in strict accordance with the above reactions and our findings.



(*A*)

(*B*)

for the difference in the relative activities of the *o*- and *p*- products of the same substance. The proximity of two groups in the *o*-position might lead to a complex of type *A*, whereas, if the groups were in the *p*-position, the configuration would be that shown in type *B*.

In this case, then, the *p*- would be twice as active as the *o*-product, a condition with which we are not as yet familiar.

In the foregoing we have not taken into consideration the effect of the accelerators upon the physical properties of the mixtures investigated, and have confined our remarks to interpretations made on the basis of excess sulfur coefficients of vulcanization only. However, in our experiments with mixtures vulcanized with the assistance of aniline, diphenylthiourea and triphenylguanidine, we were able in no instance to recover the original amount of the accelerator in the acetone extract. While this does not permit us to state definitely that a portion of the accelerator or its decomposition products, as well as the sulfur, becomes closely bound to the rubber molecule, it is not impossible that such is the case. We agree with King, that the remarkable improvement imparted to mixtures vulcanized with the assistance of certain organic accelerators indicates that the binding between the "active principle," or active group, of certain of the organic accelerators and the rubber is a close one.

In the course of another investigation shortly to be published, we have shown that fundamental differences exist between vulcanized mixtures of rubber and sulfur, and similar mixtures vulcanized with the assistance of an organic accelerator. This is subject to still further modification if either type of mixture contains a mineral oxide.

EXPERIMENTAL PART

The same general method of procedure was pursued in this work as in that previously reported.

The rubber used was good quality, first latex, pale crepe, and the same lot was employed in all mixtures. All mixtures were made under standard conditions; the average time of each batch on the mill was 17.5 min. The same proportion of rubber and sulfur—92.5 parts rubber, and 7.5 parts sulfur—was employed in each instance, but the amount of accelerator was varied, according to the conditions of the experiment.

All of the accelerators soluble in alcohol were dissolved in the smallest quantity of this liquid and introduced into the rubber in solution. Those not soluble—and this applied to the anhydro-formaldehyde bodies only—were ground to 100 mesh and added to the rubber with the sulfur. After mixing, the mixtures were allowed a recovery period of 24 hrs. before they were vulcanized. Vulcanization was carried on in a platen press of the usual type.

The vulcanized sample for analysis was then sheeted thin on the mill, subjected to 24 hrs. continuous extraction with acetone in the extractor recommended by the Joint Rubber Insulation Committee,[1] dried in air and *in vacuo* at 100° C. to constant weight. The free, or extractable, sulfur found in the acetone extract was estimated by the bromine oxidation method of the Bureau of Standards.[2] The combined sulfur in the extracted rubber was estimated by a method of our own, to be reported upon in the near future.[3] All figures given for per cent sulfur are the average of at least 2 determinations which checked to within 0.1 per cent.

PRELIMINARY EXPERIMENTS — With the exception of aniline, which was purified by distillation and boiled at 185° C., all of the accelerators shown in Table I were recrystallized from alcohol. The purified products were found to have the following melting points: urea, 132° C.; thiourea, 168° C.; monophenylthiourea, 153° C.; diphenylthiourea, 151° C.; monophenylguanidine, 193° C.; *sym*-diphenylguanidine, 147° C.; triphenylguanidine, 143° C.

In the case of the substances shown in Table II, the *p*-phenylenediamine was recrystallized from alcohol and melted at 146° C. The anhydro-formaldehyde bodies possessed the following melting points: anhydro-formaldehyde aniline, 140° C. (with decom-

[1] THIS JOURNAL, 6 (1914), 514.
[2] Bureau of Standards, *Circular* 38 (1915), 66.
[3] This method was evolved and applied in the course of the present work, in order to overcome certain disadvantages in the Rosenstein-Davies method (*Chemist-Analyst*, 15 (1916), 4) previously employed.

position; monoanhydro-formaldehyde *p*-phenylenediamine, 142° C.: dianhydro-formaldehyde *p*-phenylenediamine, 192° C.

TABLE I—RELATIVE ACTIVITIES—THIOUREA SERIES
Parts Required to Equal One Part Aniline

Aniline	1.000
Urea	0.250
Thiourea	0.300
Monophenylthiourea	0.450
Diphenylthiourea	0.850
Monophenylguanidine (*a*)	0.075
Diphenylguanidine (*Sym*)	0.075
Triphenylguanidine	0.500

The activities of the various substances were compared in the mixture previously mentioned—92.5 parts of rubber and 7.5 parts of sulfur—taking as a standard[1] the effect obtained with one part of aniline, vulcanized for 90 min. at 148° C. The amounts of various substances in the urea series required to effect the same degree of vulcanization as obtained with one part of aniline are shown in Table I. The same is true for the anhydroformaldehyde aniline series, the results of which are shown in Table II.

TABLE II—RELATIVE ACTIVITIES—ANHYDRO-FORMALDEHYDE SERIES
Parts Required to Equal One Part Aniline

Aniline	1.00
Anhydro-formaldehyde aniline	0.76
p-Phenylenediamine	0.17
Monoanhydro - formaldehyde *p*-phenylenediamine	0.14
Dianhydro-formaldehyde *p*-phenylenediamine	0.14

As these preliminary tests were conducted solely to obtain information for guidance in subsequent experiments, and as no sulfur estimations were made, we do not feel warranted in drawing extensive conclusions from them. It would appear, however, that in the case of the urea series, the introduction of phenyl as a substituent for the hydrogen of the amido or imido group is responsible for a marked decrease in the activity of the parent substance. Also, in the case of the anhydro-formaldehyde series, it is evident that the introduction of the second amino group into the benzene nucleus increases the activity of the substance to a greater extent than substituting methylene for the hydrogen in the original amino group.

FINAL EXPERIMENTS—(1) This experiment was carried

[1] The comparisons were made at what was judged to be in each case the correct cure, as measured by the physical properties of the various mixtures only. Owing to this fact, the values assigned in Tables I and II were not found to be in strict agreement with their respective sulfur coefficients as determined in the subsequent experiments. Such comparisons, based on physical properties alone, are apt to be misleading, due to the toughening action imparted to the rubber when certain accelerators are employed; this effect is very noticeable in the case of *p*-phenylenediamine.

out in order to determine the relative accelerating effects produced by certain substances which contained hydroxyl or amino groups in their primary nucleus. Determinations were also made of the effect produced when the number, or kinds, of groups in the nucleus were altered or changed.

Every effort was made to obtain the various substances in the greatest degree of purity. Their physical constants were as follows: phenol, m. p. 41° C.; *p*-amidophenol, sublimed at about 180° C.; aniline, b. p. 185° C.; hydroquinone, m. p. 168° C.; *p*-phenylenediamine, m. p. 146° C.

The relative activity of these substances, as expressed by their sulfur coefficients, is shown in Table III.

TABLE III—RELATIVE ACCELERATION

First Latex Pale Crepe..... 92.5 parts
Sulfur ..... 7.5 parts
Accelerator ..... 1 part
Vulcanized for 90 min. at 148° C.

Added Substance	Combined Sulfur-Per cent	Sulfur Coefficient	Excess Sulfur Coefficient	Group Coefficient
Control	1.792	1.937	....	....
Phenol	1.689	1.779	—0.158	—0.00163
Hydroquinone	1.436	1.561	—0.376	—0.00170
p-Amidophenol	4.772	5.210	+3.273	....
Aniline	4.236	4.614	+2.677	+0.02870
p-Phenylenediamine[1] ...	7.286	7.955	+6.018	+0.02780

[1] As the combined sulfur obtained in this instance is so close to the total amount originally added to the mixture, this comparison was repeated with 0.25 per cent aniline and *p*-phenylenediamine. When employed in this amount, aniline gave an excess sulfur coefficient of 1.631 and *p*-phenylenediamine, 3.552. On calculation, their group coefficients were found to be 0.01630 and 0.01640, respectively.

From this table, it is seen that phenol, when expressed in terms of its sulfur coefficient, has a slight retarding influence which is almost exactly doubled in the case of hydroquinone, when the molecular weight of the latter is taken into consideration. Aniline and *p*-phenylenediamine are seen to exert a marked accelerating effect, as would be expected, and here, again, the effect produced by two amino groups is almost exactly twice that of a single group when the molecular weights of the two substances (aniline and p-phenylenediamine) are taken into consideration.[1] Thus, when equal weights of certain accelerators which contain active groups in the same primary nucleus are employed, it is possible to compare the activity of these groups *per se* by means of a group coefficient. Or, conversely, molecular quantities of substances which contain the same active group (or groups, if in equal number)

[1] The alkaloidal substances mentioned by Spence as decidedly active are undoubtedly of a high molecular weight.

in the primary nucleus should produce the same accelerating activity.

In the case of equal quantities by weight, this may be expressed as follows:

$$\text{Group coefficient} = \frac{Sx}{Mn}$$

where Sx = the excess sulfur coefficient over that of a control mixture vulcanized without an accelerator.

M = the molecular weight of the accelerator.

n = the number of the groups in the primary nucleus.[1]

When the results recorded in Table III are substituted in the above expression, the coefficient for the (OH) group is seen to be in good agreement for both phenol and hydroquinone; the same is true for the coefficients obtained for the (NH_2) group in both aniline and *p*-phenylenediamine. In other words, the introduction of a second group in the para position just doubles the activity. In light of our remarks in the introductory part of this paper, in regard to the function of these groups in accelerating the reaction between rubber and sulfur, we regard this point of much more importance than the numerical coefficient of the group itself, although a properly arranged table of group coefficients would undoubtedly be of value in anticipating the activities of untried substances.

II—In the previous experiment we employed substances of comparatively simple composition, and have attributed their action as accelerators to the presence of certain active groups. In the introductory part of this paper, however, we have pointed out that the action of certain other accelerators depends upon their ability to decompose, under vulcanizing conditions and temperatures, into degradation products containing an active group which is responsible for the acceleration effected. The present experiment was designed to further emphasize this point.

For this purpose, diphenylthiourea was chosen as the standard accelerator, on the assumption that

[1] The term "nucleus" is used as distinct from "molecule," in order to preclude the inclusion of similar groups in the side chains which, as Peachey has already noted, are not comparable in the effect produced. Likewise, as our work has been confined to two groups in the para position, further extension of this principle would require the introduction of another factor to compensate for the appearance of groups in the meta and ortho positions. In most cases, the ortho, meta and para products are increasingly active in the order named. Such differentiations, however, may be carried on indefinitely to include naphthylamines, etc. We have found β-naphthylamine to be almost twice as active as α-naphthylamine.

Table IV

First Latex Pale Crepe..... 92.5 parts
Sulfur ..... 7.5 parts
Accelerator ..... X parts
Vulcanized for 90 min. at 148° C.

	X = Parts Accelerator Added to the Mixture	Physical Properties	Odor of Cured Slab	Acetone Extract Per cent (Uncorrected)	Acetone Extract Per cent (Corrected)	Free Sulfur Per cent	Combined Sulfur Per cent	Total Sulfur Per cent (By Addition)
Control	0.00	1	Standard	8.630	2.894	5.736	1.792	7.528
Phenyl Mustard Oil.....	0.59	—1	Phenyl mustard oil	8.443	2.729	5.714	1.726	7.440
Aniline	0.41	4	Decomposition products of aniline	7.065	3.127	3.928	3.626	7.553
Phenyl Mustard Oil and Aniline	$C_6H_5NCS = 0.59$ $C_6H_5NH_2 = 0.41$	3	Phenyl mustard oil and decomposition products of aniline, the latter predominating	7.966	3.595	4.371	3.100	7.471
Diphenylthiourea	1.0	2	Phenyl mustard oil and decomposition products of aniline, the latter predominating	7.429	3.119	4.310	3.078	7.388
Diphenylthiourea and Aniline.	$(C_6H_5NH)_2CS = 1.0$ $C_6H_5NH_2 = 0.41$	6	Decomposition products of aniline predominating	7.301	3.963	3.338	3.959	7.297
Triphenylguanidine	1.25	6	Strong, but indistinguishable. Phenyl mustard oil could be detected	7.523	4.063	3.460	3.872	7.332

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Equation 1 is reversible and proceeds from right to left under the conditions and temperatures at which vulcanization ordinarily takes place.

Such being the case, and in view of the probable inactivity of phenyl mustard oil, the activity exerted by one part of diphenylthiourea should be no greater than that effected by a quantity of aniline corresponding to the amount required for the above reaction, when it is proceeding towards the left. Likewise, if the accelerating effect obtained with diphenylthiourea is dependent solely upon the amount of aniline formed by the decomposition of the former substance during vulcanization, the same should be true for triphenylguanidine, in accordance with Equation 2, which should also proceed from right to left during the vulcanization.

As mentioned in the introductory part of this paper, the diphenylthiourea and aniline formed undoubtedly undergo a subsequent decomposition with the formation of 2 molecules of aniline, and 1 molecule of phenyl mustard oil.

In order to test the above, our standard mixture was vulcanized for 90 min. at 148° C., with the assistance of one part of diphenylthiourea, and compared with similar mixtures which contained molecularly equivalent amounts of either one or both of the various decomposition products indicated in the above equations. The actual amounts of the different substances employed are shown in the second column of Table IV; they showed the following physical constants: phenyl mustard oil, b. p. 220° C.; aniline, 185° C.; diphenylthiourea, m. p. 151° C.; triphenylguanidine, m. p., 143° C.

Before any sulfur determinations were made, the different slabs were submitted to thumb and tooth tests in order that a rough estimation of their relative physical properties might be recorded. As shown in Table IV, the control has been used as the standard for comparison and given the number 1. The value 2, given to diphenylthiourea, simply indicates that it was faster than 1; number 3 was considered faster than 2, and so on for the rest of the series. The differences existing between the physical properties of the various slabs, however, were in no sense proportional to the numbers given them. The odor of the cured slabs was recorded in each instance and found to substantiate the preceding equations. The results obtained for the acetone extracts of the different mixtures, together with all the sulfur estimations made, are also recorded

in detail in Table IV. To facilitate comparison, the combined sulfurs, expressed as sulfur coefficients, are tabulated in Table V in the order of their relative magnitude.

TABLE V

First Latex Pale Crepe..... 92.5 parts
Sulfur ..... 7.5 parts
Accelerator ..... X parts
Vulcanized for 90 min. at 148° C.

Accelerator	Combined Sulfur Per cent	Sulfur Coefficient	Excess (+) Sulfur Coefficient
Phenyl Mustard Oil.....	1.726	1.877	—0.060
Control (No Accelerator).....	1.792	1.937	....
Diphenylthiourea	3.078	3.361	1.424
Phenyl Mustard Oil and Aniline....	3.100	3.385	1.448
Aniline	3.625	3.935	1.998
Triphenylguanidine	3.872	4.240	2.303
Diphenylthiourea and Aniline.....	3.959	4.340	2.403

From Table V it is seen that the sulfur coefficients obtained confirmed very closely the estimates made upon the physical properties. Further, it is shown that the activity of diphenylthiourea is almost exactly equal to that obtained with an amount of aniline corresponding to the quantity formed in its decomposition products as expressed in Equation 1. Likewise, triphenylguanidine was found to have the same activity as obtained with an equivalent amount of diphenylthiourea and aniline, as required by Equation 2, when the reaction proceeds toward the left.

It is evident that the action of both diphenylthiourea and triphenylguanidine as accelerators is due to their tendency to decompose, under vulcanizing conditions and temperatures, with aniline as one of the most probable degradation products. Moreover, it would appear that the aniline so formed is responsible for the acceleration effected, and owes its activity to the presence of an active group containing nitrogen, which functions as a sulfur carrier. That in no case were we able to recover the original amount of accelerator in the acetone extract, is an indication—and an indication only—that a portion of the active principle may also remain bound to the rubber as well as the sulfur.

Final emphasis is laid upon the fact that all of our results have been obtained with a mixture composed of rubber, sulfur, and accelerator only. The presence in the mixture of inorganic oxides has been found to have a marked influence on both the chemical and physical results obtained after vulcanization.

CONCLUSIONS

In view of the preceding results, we have been led to the following conclusions:

1—Comparisons of organic substances as accelerators should be made with molecularly equivalent amounts of the substances in question, and should be based on the values obtained for their excess sulfur coefficients over that of a control which contains no accelerator.

2—The action of certain substances, such as diphenylthiourea, is due to their tendency to decompose under vulcanizing conditions and temperatures into simpler substances which contain an active nitrogen group which is responsible for the acceleration effected.

3—Molecularly equivalent quantities of substances which contain the same active nitrogen group in their primary nucleus effect the same accelerating activity.

4—The replacement of the hydrogen in the active nitrogen group by other and larger groups, or radicals, decreases the activity of the parent substance.

5—The activity of the nitrogen in certain groups is most readily interpreted as due to a change in valency from three to five, with the temporary addition of sulfur; the active nitrogen group would thus function as a sulfur carrier.

845

V

The Republic Rubber Company

Factory and General Offices, Youngstown, Ohio.

Youngstown, Ohio,

December
First,
1 9 1 9.

IN REPLY PLEASE REFER TO _____

Defts Ex. No. V
U. S. Dist. Court,
S. D. of N. Y.
JAN 5
G Rel-23

Mr. George H. Stevens,
845 Broad St.,
Newark, N. J.

My dear Mr. Stevens:

In answer to yours of the 27th, I think that it would be wise to get your material together and come back at the end of this week, as I expect to be away from Thursday to Monday or Tuesday of next week. There will hardly be any time for further correspondence, therefore, please accept these instructions as final.

Very truly yours,

THE REPUBLIC RUBBER COMPANY

CHIEF CHEMIST.

P.S. on re-reading your letter, I'm not sure but that you are spending a little too much time on Triphenyl. Remember we are there only that. Diphenyl is the key pin now. Mark.

NHC-B

Defts. Exhibit F
Oct 8/25
H. M. C.

138

Defendnt's Exhibit F

DOVAN CHEMICAL CORPORATION

SYMMETRICAL DIPHENYLGUANIDINE

I. *Chemical Composition and Physical Properties.*

Symmetrical Diphenylguanidine $(C_6H_5NH)_2C:NH$ is a disubstituted guanidine and may be considered as thiocarbanilid in which the sulphur of the =C =S group has been replaced by the imid (=N=H) group.

Symmetrical Diphenylguanidine is a mono-acid base difficultly soluble in cold water, somewhat more soluble in boiling water. Its aqueous solution is strongly alkaline to phenol-phthalei It is soluble in practically all of the common organic solvents and is best re-crystallized from toluo in which it is very soluble in the hot but is almost insoluble in the cold.

The commercial material as offered by us to the rubber trade for use in accelerating th vulcanizing of rubber is a white, extremely finely divided powder, of a high degree of purity guaranteed to conform to the following specifications:

Melting Point	145-147° C.
(Chemically pure material melts at 147° C.)	
Ash	.3% Max.
Moisture	.3% Max.
Insoluble in dilute HCl	.2% Max.
Fineness	100% through 100 mesh
Color	Almost snow white

The impurities present consist of traces of ash and moisture and a small amount of organic impuri ties, the finished material assaying approximately 98.5% Diphenylguanidine. It is almost odorless is non-poisonous to workmen handling it in rubber manufacturing, and vulcanized articles containing it are odorless and free from all poisonous or objectionable fumes. This is particularly advantageous in all mechanical molded goods as it protects the health and increases the efficiency of the press or heater operator.

II. *Method of Handling Diphenylguanidine in the Factory.*

Since the material is a dry powder, and positively non-hygroscopic, no special methods of handling it are necessary, as it can be weighed as such and added directly to the batch to be mixed. Due to the extreme fineness of subdivision of Dovan Diphenylguanidine it disperses easily and completely in the rubber mix, thus insuring a uniform cure throughout the article.

If it is preferred to handle the material in the form of a master batch with rubber, 20 to 25% or even more can be very easily incorporated in the rubber. In mixing the master batch the rubber should be well masticated and then the DPG should be fed on slowly with a scoop, thus eliminating any tendency on the material to cake on the back roll. The final mix when cold is somewhat stiffer than crude rubber, and can be stored in any amount without fear of flowing together or deteriorating in any way.

III. *Characteristics of Diphenylguanidine as an Accelerator of Vulcanization.*

A. *Universal Applicability.*

Unlike nearly all other commercial available organic accelerators, diphenyl-guanidine can be used advantageously in all classes of rubber compounds, and in conjunction with all the known compounding ingredients. This is a very decided advantage, as it is not necessary to carry several accelerators in stock to use for special purposes, as is generally the case with other accelerators.

Defendant's Exhibit "G."

B. *Effects on Colors.*

Diphenylguanidine can be used in conjunction with practically all of the organic and inorganic colors without dulling or changing the tone in any way. This makes it very valuable for non-blooming inner tubes, drug sundries, etc., where a clean, bright color is essential.

C. *Critical Temperature.*

Although Diphenylguanidine is an exceeding active accelerator, its critical temperature is enough above the temperature attained on the calendar and mill to insure almost complete freedom from scorching. This makes it possible to compound very quick cure compounds, and is especially valuable for use in heavily compounded stocks such as tire treads, mechanical goods, drug sundries, and the like.

D. *Effect of Zinc Oxide.*

Although Diphenylguanidine is very active in a purely rubber-sulphur mix, zinc oxide is of assistance in producing its maximum accelerative effect. The maximum effect is produced by using five parts by weight of zinc oxide per 100 parts by weight of rubber. It is recommended that not less than three and preferably five parts by weight of zinc oxide be used per 100 parts rubber. Lime, magnesia and litharge activate Diphenylguanidine to some extent especially in hard rubber.

E. *Proportion of Sulphur to Rubber.*

Unless non-blooming stocks are required, the best stocks can be produced by using from 3 to 4 parts of sulphur to 100 parts of rubber. In general, it is best to use 3.5 parts sulphur per 100 parts rubber. This proportion gives a stock with a very flat curing curve, and insures good ageing qualities.

F. *Proportion of Accelerator to Rubber.*

Unlike many other accelerators, Diphenylguanidine is very active when present in very small amounts, and its activity increases almost proportionally to the increase of Diphenylguanidine up to about 0.75 parts per 100 parts of rubber. The best compounds are produced by using from 0.5 parts to 0.8 parts of Diphenylguanidine per 100 parts of rubber, using 3.5 parts of Sulphur.

G. *Ageing Qualities of Diphenylguanidine Compounds.*

Compounds accelerated with Diphenylguanidine age extremely well, especially when the proportion of sulphur to rubber is proper. Although it is recommended to use not over 3.5-4.0 parts of sulphur, stocks have been made having as much as 6.0-7.0% sulphur that aged very well. Here again Diphenylguanidine is shown to be a very advantageous accelerator, and one of wide applicability.

I. *Type Compounds for Various Rubber Articles.*

A. *Inner Tubes.*

1. *Gray—Light Bloom.*

Rubber	100.
Sulphur	3.5
Zince Oxide	5.
Diphenylguanidine	.6

Carbon Black or Lamp Black to suit.

This compound should be cured 30-35 minutes at 288° F. in open steam, depending upon the nature of rubber used. It is a lightly blooming tube, has excellent resistance to tear and ages extremely well. 0.5 to 1.0 parts cotton-seed oil may be added to decrease any tendency to check when exposed to light.

2. *Heavy Blooming Tube.*

Rubber	100.
Sulphur	5.
Zinc Oxide	5.
Diphenylguanidine	.125

This stock should be cured 40-45 minutes at 288° F. It is a heavy blooming tube, but ages very well.

3. *Non-blooming Colored Tubes.*

Rubber	100.
Sulphur	2.5
Zinc Oxide	5.
Diphenylguanidine	.75

To the above mixture may be added carbon black, red oxide, golden or crimson antimony free from free sulphur, or any of the organic colors to produced desired shade. The above should be cured about 60 minutes at 288° F. to be non-blooming. The physical properties and aging qualities are very good and colors are particularly clear.

Tire Compounds.

1. *Friction, skim coat, cover stocks, etc.*

The following type compound can be used to produce high rubber stocks of any cure desired.

Rubber	100.
Sulphur	3.5 to 4.0
Zinc Oxide	5. to 25.
Diphenylguanidine	.4 to 0.75

If the following recipe be used:

Rubber	100.
Zinc Oxide	5.
Sulphur	3.75
Diphenylguanidine	0.75

the best technical cure is from 30 to 35 minutes at 288° F.

To the above can be added Mineral Rubber, Softeners and Fillers to suit.

2. *Sidewall Stocks.*

Rubber	65.
Sulphur	2.25
Zinc Oxide	30.
Diphenylguanidine	.3
Color to Suit.	

3. *Tread Stocks.*

Rubber	92.5 = 100 vol.
Sulphur	3.5
Diphenylguanidine	.75 to 1.0

To the above may be added the necessary pigments to obtain rigidity desired. The cure will depend entirely upon what compounding ingredients are added, and their amounts, as some materials retard a great deal, others slightly, others are neutral, and some are slightly accelerative.

Cure on the above type compounds with 5 to 10 parts Zinc Oxide added to activate the Diphenylguanidine is 30 minutes at 288° F.

Using 20 vol. Carbon Black, Cure = 45 to 70 minutes at 288° F., depending on brand used.

Barium Sulphate, Whiting, Lithopone and Aluminum Flake are Neutral, curing in 30 minutes at 288° F.

China Clays retard slightly, curing in 40 to 45 minutes at 288° F.

4. *Hard Rubber.*

Diphenylguanidine is an exceedingly valuable accelerator for hard rubber goods. It has great curing power and is odorless. Heavily loaded stocks can be milled without danger of scorching. The texture of hard rubber produced with Diphenylguanidine is unequalled.

5. *Dry Heat Compound.*

Diphenylguanidine also will give excellent results in dry heat cures. It will replace litharge and give comparable results with a shorter cure. In addition, it can be used in light colored stocks. It is recommended to use 1.5-2.0% of Diphenylguanidine and 2.5-3.0% of Sulphur. The time of cure will depend on the rapidity of the rise and on the temperature.

COPY BOUND CL

6. *Molded Goods.*

The use of Diphenylguanidine is very advantageous for many reasons. It is universally applicable to all sorts of compounds and shows high curing power in presence of reclaimed rubber and every sort of cheap compounding material, such as mineral rubber, resins, pitches, waxes, etc. Most important of all in this class of goods is the fact that no unpleasant fumes are given off from the hot goods when the molds are opened, which protects the workman and increases his efficiency:

Following is a type formula for heel stocks:

Rubber	25.
Reclaim (Tire)	25.
Sulphur	1.25 to 1.5
Diphenylguanidine	.5 to .6
Zinc Oxide	10.
Carbon Black or Red Oxide..	5.
Clay	30.
Softener	1.25

Cure: 10 to 15 minutes at 65 to 70 lbs. steam pressure.

SUMMARY:

The advantages of Diphenylguanidine are:

1. Non-poisonous to handle, odorless and free from all objectionable fumes.
2. No special means of handling are necessary, as it is a finely divided, dry, non-hygroscopic powder.
3. It is applicable to every class of rubber compound.
4. Works in conjunction with all compounding ingredients.
5. Very active in presence of reclaimed rubber.
6. Does not dull or destroy organic colors.
7. If the sulphur to rubber proportion is proper, the stocks have a long flat curing curve and are therefore foolproof.
8. Its critical temperature is high enough to prevent scorching.
9. It is very active, even in very low percentages.
10. Properly compounded, stocks age extremely well, and have very little tendency to overcure.
11. Produces non-blooming stocks of very good qualities.
12. Produces pure gum compounds with a very high resistance to tear, therefore valuable in tube stocks.
13. Does not lose its curing power on being stored or when milled into compounds, no matter how long they are kept.
14. Low specific gravity—being less than 1.
15. It has a basic reaction and therefore keeps the rubber in vulcanized compounds in a non-polymerized state which is most conducive to good ageing.

SE IN CENTER

Defendant's Exhibit "H."

File wrapper of patent in suit.
(Consisting of 68 pages)

851

NUMBER (Series of 1915).
514 727

1921

(EX'R'S BOOK) 145-2

DIV. 15

PATENT No. 1411231

MAR 23 1922

Name Morris L Kerr
Assor to Dovan Chemical Corporation of Wilmington, Del. a corp of Delaware

of Brooklyn.

County of

State of New York

Invention Vulcanization Accelerator

	ORIGINAL	RENEWED
Petition	Nov. 12, 1921	, 19
Affidavit	" " , 1921	, 19
Specification	" " , 1921	, 19
Drawing	, 19	, 19
Photo Copy	, 19	, 19
First Fee Cash $15	Nov. 12, 1921	, 19
" " Cert.	, 19	, 19
Appl. filed complete	Nov. 12, 1921	, 19
(Signed) W. L. Redman	Oct 28, 1922	
Examined and Passed for Issue	Feb 14, 1922	, 19
(Signed) W. L. Redman	Exr. Div. 15	
Notice of Allowance	Feb 15, 1922	, 19
Final Fee Cash $20	Feb 17, 1922	, 19 2
" " Cert.	, 19	, 19
Patented		, 19

Attorneys Sheffield & Betts, 52 William St, New York City

Associate Attorney

(No. of Claims Allowed 12) (Print Claim) in O. G. (Cl. 18-53)

Title as Allowed Vulcanization Accelerators

144

Sig. 2.

852

JAMES F. SHEFFIELD
L. P. M. BETTS
JOHN W. PETERS
JAMES J. OSBORNE
EDWARD W. VAILL
ABEL E. BLACKMAR, JR.

SHEFFIELD & BETTS
COUNSELLORS AT LAW
52 WILLIAM STREET
New York

SAMUEL A. BETTS
COUNSEL

November 10th, 1921.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:-

We are enclosing herewith for filing an application of Morris L. Weiss for improvements in "Vulcanization Accelerators", together with our check for $15.00 to cover the cost of filing said application.

Respectfully,

Sheffield & Betts

JH.

Enclosure.

145

853
appln

PETITION AND POWER OF ATTORNEY

To the Honorable Commissioner of Patents:

Your Petitioner MORRIS L. WEISS

a Citizen of the United States of America,

Residing in Brooklyn, County of Kings, State of New York

and whose Post Office Address 2812 Church Ave., Brooklyn, N. Y.

respectfully prays that Letters Patent of the United States of America may be granted to your petitioner for the improvements in

VULCANIZATION ACCELERATORS

set forth in the annexed specification, and your petitioner hereby appoints James R. Sheffield, Louis Frederic Holbrook Betts, John W. Peters, James J. Cosgrove, Edward W. Vaill and Abel E. Blackmar, Jr., composing the firm of Sheffield and Betts, of No 52 William Street, Borough of Manhattan, in the City and State of New York, Attorneys at Law, whose registration number is 3902, or their accredited agent or agents, as attorneys in the premises, with full powers of substitution and revocation, to prosecute this application, to sign the drawings, to make and sign alterations and amendments, to receive the letters patent when granted and to transact all business in the Patent Office connected with said application.

Morris L Weiss

~~SPECIFICATION~~

TO ALL WHOM IT MAY CONCERN:

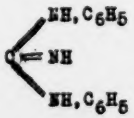
BE IT KNOWN that I, MORRIS L. WEISS, a citizen of the United States, residing in the Borough of Brooklyn, County of Kings, City and State of New York, have invented certain new and useful improvements in

VULCANIZATION ACCELERATORS,

of which the following is a full, clear, concise, and exact description.

The object of my invention is to improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose. It is known that when certain organic substances are added to the rubber mix during the compounding, a catalytic or similar action is produced which causes the rubber or similar gum to unite or react more rapidly and thoroughly with sulphur or other vulcanizing agents.

I have discovered that disubstituted guanidines particularly diphenylguanidine is particularly effective for this purpose. This substance is indicated by the formula



I am aware that disubstituted guanidines have been produced by laboratory methods and have been known to chemists for many years beginning about the year 1868

with the work of A. W. Hoffman (An. Chem. Parm. 67:129), but down to time of my researches in accelerators of this type, it was apparently not known that di-substituted guanidines were efficacious or useful as accelerators in vulcanizing, nor that this substance could be produced in sufficiently large quantities in a substantially pure form, or at a sufficiently low cost to be available for this purpose.

I am aware that triphenylguanidine has been suggested, and probably used to some extent, as an accelerator in the vulcanization of rubber, but the use of diphenylguanidine for that purpose appears to have been unknown prior to my researches on this substance.

I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but results in a final product much superior in texture, strength, durability and aging qualities over that when the triphenylguanidine is used. A greatly improved product also results when diphenylguanidine is used as an accelerator in the vulcanization of soft rubber compounds, particularly as regards elasticity, aging qualities and freedom from "bloom". In these and similar instances, it has been found that the use of triphenylguanidine requires from two to three times as long a period in vulcanizing as when diphenylguanidine is used, particularly at lower heat or steam pressures than those commonly employed.

In my prior application Serial No. 482,143

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filed July 2, 1921, I have described and claimed a proces for producing and purifying diphenylguanidine in commerci quantities, and have therein given a resume of the histor cal development of the methods of producing the same.

As set forth in said application, I, at present prefer to produce my improved accelerator by desulphuriz thiocarbanilide by the action of a metallic oxide, such a lead oxide, zinc oxide, etc., in an alcoholic solution of an ammonium salt, such as ammonium nitrate.

The present patent application therefore relate to the vulcanization of rubber or similar substances, in which disubstituted guanidines are employed as the accele ating agent or catalyzer, and particularly diphenylguanid

The method of carrying out my invention, which at present deem preferable, may be illustrated by the fol lowing example:

The rubber may be compounded in the following propor tions: 50 ~~.00~~ parts by weight of new rubber,
45.5 " " " " zinc oxide,
3.5 " " " " sulphur,
1 ~~.00~~ part " " " diphenylguanidine.

These are mixed together in any suitable way, such as by milling, and then vulcanized or cured in the usual molds or otherwise under heat corresponding to a steam pressure of about 40 lbs. per square inch. This vul canizing temperature should be continued until the compou is suitably vulcanized, which requires from 10 to 20 minut depending upon the shape and size of the articles being vulcanized.

It will therefore be appreciated that when usin the accelerator according to my invention the vulcanizati

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COPY BOUND C

is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable where it is desired to produce a harder or less elastic portion in an article leaving other parts which are reqdred to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts or a single article may be cured to different degrees of hardness without danger of over-curing the softer or more elastic parts. I have found moreover than diphenylguanidine does not need zinc oxide to shorten the time of cure. I however prefer to use zinc oxide on account of its effects on the physical properties of the product.

Having thus described this example of my invention and the method of using the same, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, etc., indicated, for various changes may be made without departing from the essential features of my invention as set forth in the accompanying claims.

What I claim and desire to protect by Letters Patent is:

OSE IN CENTER

1. The process of treating rubber or similar materials, which comprises combining with the rubber compound a di-substituted guanidine.

2. The process of treating rubber or similar materials which comprises combining with rubber compound a di-substituted guanidine comprising two phenyl radicles or groups.

3. The process of treating rubber or similar materials which comprises combining with the rubber compound an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

4. The process of treating rubber or similar materials which comprises combining with the rubber compound diphenylguanidine.

5. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine accelerator.

6. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and a di-substituted guanidine comprising two phenyl radicles or groups.

7. The process of treating rubber or similar materials which comprises combining with the rubber compound a vulcanizing agent and an accelerator derived from

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thiocarbanilide in which the sulphur is substituted by an imide group.

8. The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine.

9. A vulcanizing compound of rubber or similar material combined with a vulcanizing agent and a di-substituted guanidine.

10. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and di-substituted guanidine comprising two phenyl radicles or groups.

11. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and an accelerator derived from thiocarbanilide in which the sulphur is substituted by an imide group.

12. A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine.

Signed at New York, N. Y.,
November 10th, 1921.

Morris L. Weiss

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AFFIDAVIT

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

MORRIS L. WEISS

the above-named petitioner, being sworn, deposes and says that he is a citizen of the United States of America,

and resident of the Borough of Brooklyn, County of Kings, City and State of New York,

that he verily believes himself to be the original, first, and sole inventor of the improvements in VULCANIZATION ACCELERATORS

described and claimed in the annexed specification; that he does not know and do as not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months before this application, or in public use or on sale in the United States for more than two years prior to this application; and that no application for patent on said improvements has been filed by him or his legal representatives or assigns in any country foreign to the United States.

Morris L. Weiss

Sworn to and subscribed before me this
10th day of November, 192

Walter S. Jones
Notary Public,
New York County.

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Dr. 15 Room 308 — 2-200 — Page No. 2

Address only "The Commissioner of Patents, Washington, D.C." and not by official by name.

H/MEY

All communications relative to securing this application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Dec. 29,1921

Sheffield and Betts

52 William St.

New York, N.Y.

Please find below a communication from the EXAMINER in charge of the application of

M.L.Weiss,Ser.No.514,727,filed Nov.12,1921; Vulcanization Accelerators.

Thomas E. Robertson

Commissioner of Patents.

This case has been examined.

The claims are rejected on

India Rubber World May 1,1921 page 372- second column 3rd paragraph line 4 "Diphenylguanidine".

The India Rubber World is published in New York by Henry C Pearson.

A new oath is required, the present one being dated Nov.10,192

A. V. Chandler

act. Examiner.

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IN THE UNITED STATES PATENT OFFICE

In re Application of

MORRIS L. WEISS

Serial No. 514,727 Division 15 - Room 308

Filed November 12, 1921

VULCANIZATION ACCELERATORS

New York, N. Y., January 3, 1922

TO THE HONORABLE COMMISSIONER OF PATENTS

Washington, D. C.

S i r :

Official action of December 29, 1921, received. The rejection of the claims on the publication in the India Rubber World of May 1, 1921, is noted. It is also noted that said publication refers to a paper read at the meeting of the American Chemical Society in Chicago, September 6-10, 1920. In view of this latter date, which purports to mention the use of the accelerator of this application in September, 1920, the affidavits herewith submitted under Rule 75 of the Rules of Practice have been drawn to ante-date said latter date of September 6, 1920, instead of May 1, 1921, the actual date of the publication and the one legally effective as a publication under the statutes. Therefore, the accompanying affidavits of Morris L. Weiss, the inventor, and Henry S. Doty, President of the assignee company, the Dovan Chemical Corporation, are herewith submitted, which clearly show not only

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reduction to practice, but the marketing of the accelerator involved in this application prior to September 6, 1920.

It is thought that these affidavits now put this case in condition for allowance. In view of applicant's copending allowed case involving the process of making this accelerator, it is requested that this case be taken up for action and allowance at the earliest possible date in order that these two cases may issue together to avoid any question of conflict between them.

A new oath is submitted herewith, as required, although the applicant's file copy of the same indicates that the date of execution is complete.

Very respectfully

MORRIS L. WEISS

By Shuffred & Betts.

his Attorneys.

IN THE UNITED STATES PATENT OFFICE

In re Application of

MORRIS L. WEISS

Serial No. 514,727 — Division 15 - Room 808

Filed November 12, 1921

VULCANIZATION ACCELERATORS

- AFFIDAVIT OF MORRIS L. WEISS -

STATE OF NEW YORK)
(SS.:
COUNTY OF NEW YORK)

MORRIS L. WEISS, being duly sworn, deposes and says as follows:

I am the applicant named in the above entitled application, Serial No. 514,727, filed November 12, 1921. I am a chemist employed by the Dovan Chemical Corporation, assignee of said application. The invention, which is the subject matter of the claims, was conceived, disclosed to others and reduced to practice by me prior to September 6, 1920, and said reduction to practice comprised the actual use of diphenylguanidine as an accelerator in the vulcanization of rubber articles.

FURTHERMORE, said diphenylguanidine was placed on the market for use by manufacturers of rubber goods by the predecessors of said Dovan Chemical Corporation prior to September 6, 1920.

I also depose and say that I do not know and do not believe that said invention has been in public use or on sale in the United States or patented or described

in a printed publication in the United States or any foreign country for more than two years prior to my said application and that I have never abandoned the said invention.

Morris L. Weiss

Sworn to before me this 3rd day of January, 1922.

Walter S. James
Notary Public
New York Co.

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IN THE UNITED STATES PATENT OFFICE

In re Application of

MORRIS L. WEISS

Serial No. 514,727 — Division 15 - Room 308

Filed November 12, 1921

VULCANIZATION ACCELERATORS

- AFFIDAVIT OF HENRY S. DOTY -

STATE OF NEW YORK)
(SS.:
COUNTY OF NEW YORK)

HENRY S. DOTY, being duly sworn, deposes and says as follows:

I am President of the Dovan Chemical Corporation, assignee of the application of Morris L. Weiss, Serial No. 514,727, filed November 12, 1921, for vulcanization accelerators. To my personal knowledge, the invention stated in the claims of said application was disclosed to me, reduced to practice and successfully used by said Morris L. Weiss prior to September 6, 1920.

FURTHERMORE, diphenylguanidine made in accordance with the specification and claims of said application was put on the market by the predecessors of said Dovan Chemical Corporation and was delivered to manufacturers of rubber goods as an accelerator for use in rubber vulcanization prior to September 6, 1920.

Henry S. Doty.

Sworn to and subscribed before
me this 4th day of January, 1922.

Walter D. Jones.
Notary Public
New York Co.

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AFFIDAVIT

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

MORRIS L. WEISS

the above-named petitioner, being sworn, deposes and says that he is a citizen of the United States of America, and resident of Borough of Brooklyn, County of Kings, City and State of New York; that he is the applicant named in application Serial No. 514,727, filed November 12, 1921, that he verily believes himself to be the original, first, and sole inventor of the improvements in VULCANIZATION ACCELERATORS described and claimed in the said application; that he do es not know and do es not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his said invention or discovery thereof, or more than two years prior to his said application, or patented in any country foreign to the United States on an application filed by him or his said legal representatives or assigns more than twelve months before his said application, or in public use or on sale in the United States for more than two years prior to his said application; and that no application for patent on said improvements has been filed by him or his said legal representatives or assigns in any country foreign to the United States.

Morris L. Weiss

Sworn to and subscribed before me this 3rd day of January, 1922

Walter S. Jones
Notary Public,

New York County.

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54.2.

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Div. 15 Room 308 2-868 Paper No. 4

Address only "The Commissioner of Patents, Washington, D.C." and not any official by name.

All communications concerning this application should give the serial number, date of filing, title of invention, and name of the applicant.

H/MFY

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Jan.13,1922

Sheffield and Retts

52 William St.

New York, N.Y.

Please find below a communication from the EXAMINER in charge of the application of

Morris L Weiss,Ser.No.514,727,filed Nov. 12,1921;

Vulcanization Accelerators.

Thomas E. Robertson

Commissioner of Patents

In response to letter of Jan.6,1922

The affidavit filed under Rule 75 is not sufficiently specific as to the facts presented therein.

Merely stating that the invention was disclosed to others before Sept. 6,1920 and reduced to practice - does not bring out all the facts in applicant's possession To whom was it disclosed and when? When was it placed on the market and where? There must be a completion of the invention in this country before the date of the reference. Furthermore a public address before the American Chemical Society disclosing completely the invention on Sept. 6,1920 shows knowledge which applicant must overcome by bringing his dates back of Sept.6, 1920.

The new oath under Rule 46 has been filed and accepted.

The affidavit under Rule 75 is rejected, and the claims stand rejected.

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M. L. Reams

IN THE UNITED STATES PATENT OFFICE.

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#5

In re Application of : Division 15, Room 308.

MORRIS L. WEISS, :

Serial No. 514,727; : VULCANIZATION ACCELERATORS

filed November 12, 1921.:

- - - - - - - - - - - - - -

New York, January 19, 1922.

HON. COMMISSIONER OF PATENTS,

Washington, D. C.

Sir:-

The Official action of January 13, 1922, received. In accordance with said Official action, additional affidavits are submitted herewith, said affidavits having been executed by the inventor, Morris L. Weiss, and Henry S. Doty and Chester Frankenstein. It is thought that these affidavits now fully set forth the specific facts and include the dates and location of the same. Said affidavits clearly anticipate the date of September 6, 1920, mentioned by the Honorable Examiner, and therefore invalidate the reference to the India Rubber World cited in the previous Office action. In view of this, it is thought that the application is now in condition for allowance, and in view of applicant's co-pending allowed application serial No. 482,143, filed July 2, 1921, for a process for producing and purifying diphenylguanidine, it is requested that early action be taken in this case, for

the reasons previously set forth. Said prior application is mentioned in the specification herein at the bottom of page 2 and at the top of page 3.

Early and favorable action is solicited.

Very respectfully,

MORRIS L. WEISS,

By Shumway & Sells
his Attorneys.

IN THE UNITED STATES PATENT OFFICE.

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In re Application of : Division 15; Room 308.

MORRIS L. WEISS, :

filed November 12, 1921;: VULCANIZATION ACCELERATORS.

Serial No. 514,727. :

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AFFIDAVIT OF MORRIS L. WEISS.

State of New York,)
: ss.:
County of New York)

MORRIS L. WEISS, being duly sworn, deposes and says as follows:

I am the applicant named in the above entitled application serial No. 514,727, filed November 12, 1921. I am a chemist employed by the Dovan Chemical Corporation, assignee of said application. The invention which is the subject matter of the claims thereof was conceived by me prior to January 1, 1920.

On or about the 7th day of April, 1920, I called at the office of Mr. Henry S. Doty and Mr. Van Lear Woodward, at 30 Church Street, New York City, and disclosed to them the said invention, and also delivered to them, at said time and place, a sample of diphenylguanidine which I had previously prepared for use as an accelerator in rubber vulcanization. I then and there explained to them the purpose and manner of its use. Said Doty and said Woodward agreed to make a test of said invention using said sample as an

accelerator for rubber vulcanization, and accordingly tests were conducted by said Doty at the laboratories of the States Metals Company at Long Island City, New York. on or about April 8th, 1920. I was thereafter informed, within two or three days, by said Doty and said Woodward that said tests had been made and were considered by them to clearly demonstrate the success, value and practicability of said invention.

Thereupon it was mutually agreed between said Doty, said Woodward and the deponent that they should co-operate with each other in placing said diphenylguanidine on the market as an accelerator for rubber vulcanization.

Preparations for the manufacture of diphenylguanidine in commercial quantities was then begun and during the period from May, 1920, to September, 1920, about one hundred and fifty pounds of diphenylguanidine had been manufactured at the laboratories equipped for that purpose and located at 980 East 35th Street, Brooklyn, New York, by said Doty and Woodward and the deponent.

During the month of August, 1920, various rubber goods manufacturing concerns were advised by letters of the availability of diphenylguanidine as an accelerator for rubber vulcanization, and beginning about the last week in August, 1920, samples of the same were sent to a number of rubber goods manufacturers, including the General Tire and Rubber Company, of Akron, Ohio, and New Castle Rubber Co., New Castle, Pa.

Sales of said accelerator were begun about the latter

part of September, 1920, and have been continued by said Doty, Woodward and the deponent and by the States Metals Company as the distributing organization of the Dovan Chemical Corporation, the assignee of the present application, which corporation succeeded said Doty and Woodward and the deponent as manufacturers thereof. The manufacture and sale of said accelerator was thereafter continued without interruption until the present date except for a period of several weeks when the factory or laboratories of the Dovan Chemical Corporation in Brooklyn, New York, was destroyed by fire, and a new factory put in operation at Newark, New Jersey

I also depose and say that I do not know and do not believe that said invention has been in public use or on sale in the United States or patented or described in any printed publication in the United States or in any foreign country more than two years prior to my said application, and I have never abandoned said invention.

M. L. Weiss
Morris L. Weiss

Sworn to and subscribed before me this 27th day of January, 1922.

Walter S. Lewis.
Notary Public,
New York Co.

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IN THE UNITED STATES PATENT OFFICE.

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In re Application of : Division 15; Room 306.

MORRIS L. WEISS, :

filed November 12, 1921; : VULCANIZATION ACCELERATORS

Serial No. 514,727. :

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AFFIDAVIT OF HENRY S. DOTY.

State of New York,)
: ss.:
County of New York)

HENRY S. DOTY, being duly sworn, deposes and says as follows:

I am President of the Dovan Chemical Corporation, assignee of the above mentioned application.

On or about April 7, 1920, Morris L. Weiss called at my office, 30 Chruch Street, New York City, and disclosed to myself and Van Lear Woodward the invention set forth in said application. Said Weiss also delivered to me at said time and place a sample of diphenylguanidine and explained to me and said Woodward the manner and method of using the same in the vulcanization of rubber articles. Thereupon deponent agreed to make tests of said sample and on or about April 8 said tests were conducted by the deponent at the laboratories of the States Metals Company at Long Island City, New York. The deponent was assisted in said tests by Chester Frankenstein. These tests were made by introducing said accelerator

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into so-called "tread stock" for automobile tires and then vulcanizing the same. Parallel tests were also conducted at the same time using hexamethylene tetramine in the same proportions as an accelerator. The results of said tests showed that diphenylguanidine was much superior to hexamethylene-tetramine as an accelerator.

During the month of June, 1920, the deponent made a series of tests at said laboratories using diphenylguanidine as an accelerator and also compared the same with the action of hexamethylene tetramine. A report of said test was made on or about June 15, 1920, a copy of which is attached hereto marked "Exhibit A". Both of said tests demonstrated to me the success, practicability and value of said invention. After the test of April, 1920, said Weiss and Woodward and the deponent agreed to co-operate in the manufacture and sale of diphenylguanidine as an accelerator. Preparations were then made for the manufacture of the same in commercial quantities.

During the month of June, 1920, sufficient quantities of chemicals were purchased by said Weiss and Woodward and the deponent to start the manufacture of said accelerator. Copies of invoices for said chemicals are attached hereto and marked "Exhibit B". Thereafter, from June, 1920, to September 1920, about one hundred and fifty pounds of the same were manufactured at laboratories equipped for that purpose at 980 East 35th Street, Brooklyn, New York.

During the month of August, 1920, various rubber goods manufacturing concerns were advised of the availability of diphenylguanidine as an accelerator for rubber vulcanization through letters sent to said concerns. Copies of such letters are attached hereto as "Exhibit C". In this "Exhibit C" references to "XLO" refer to the accelerator comprising diphenylguanidine as the active ingredient thereof. Beginning about the last week in August, 1920, samples of the same were sent to various manufacturers of rueber goods, including the General Tire and Rubber Company, of Akron, Ohio, and Goodyear Tire & Rubber Company, Akron, Ohio, and others.

Sales of said accelerators were begun about the latter part of September, 1920, and were made to various rubber manufacturing concerns, including the Dunlap Tire & Rubber Company of America, Buffalo, New York, and the Mason Tire & Rubber Company, at Kent, Ohio, and others.

H&B See order of Exhibit D"

Said sales were continued by said Weiss, Woodward and the deponent and by the States Metals Company as distributing organization for them and for the subsequently incorporated Dovan Chemical Corporation, which manufactured said accelerator as successor of said Weiss, Woodward and deponent Said manufacture was carried on continuously at the factory and laboratories of Dovan Chemical Corporation and their said predecessors, which factory and laboratories were located at Brooklyn, New York, until destroyed by fire on or about September 8, 1921, said manufacture being then interrupted for several weeks until the equipment of a new factory at Newark, New Jersey, was completed, where said manufacture has since

been continued.

Henry S. Doty.

Sworn to and subscribed before
me this 17th day of January,
1922.

Walter S. Jones.
Notary Public,
New York Co

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EXHIBIT A

LABORATORY REPORT

New York, June 15, 1920.

File Accelerator Tests

Test No. Made by Checked by H.S.D.

Sample of Diphenylguanidine

From M. L. Weiss

Reference Compare accelerative action vs. Hexamethylene Tetramine.

Tested in See below * compound. Laboratory recipe No. ---

Cure	15min @ 40#		25min @ 40#		35min @ 40#		50min @ 40	
~~Specific Gravity~~	Hexa	DPG	Hexa	DPG	Hexa	DPG	Hexa	DPG
Tensile strength per sq. inch	1432	2702	2424	3040	2718	3646	3054	344
Elongation at break	660%	580%	610%	560%	600%	540%	550%	510%

Permanent Set

[One inch sample stretched to inches for 10 minutes, released, and measured after 10 minutes rest period.]

REMARKS-

Smoked Sheets	Plantation Rubber	50%
	Zinc Oxide	46-3/4%
	Sulphur	3-1/2%
	Accelerator	3/4%

(Weight of Diphenylguanidine in the "D.P.G." compound exactly equal to weight of Hexamethylene Tetramine in "Hexa" compound in order to get comparative accelerative action.)

HSD/M

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TELEPHONE, HANOVER 5696

NEW YORK, N. Y., JUNE 21st, 1920.

Mr. M. L. Weiss, % Frazar Co., 30 Church St., New York City, N. Y.

To L. PLASS COMPANY, Dr.

130 PEARL STREET

TERMS: Net cash. PAYABLE IN NEW YORK EXCHANGE

1 drum CAUSTIC SODA 76% GROUND

523 lbs. net at 6-3/4¢ per lb. $35.30

541-18-523 lbs.

Shipped to-

H. E. Winfield-
980 East 35th St.,
Brooklyn- N. Y.

I Rec'd

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ALL CLAIMS MUST BE MADE WITHIN TEN DAYS FROM RECEIPT OF GOODS.

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EXHIBIT B (.)

TELEPHONE, HANOVER 5666

NEW YORK, N. Y., JULY 21st, 1920.

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Mr. M. L. Weiss, & Frazar Co., 30 Church St., New York City, N. Y.

To L. PLASS COMPANY, Dr.

130 PEARL STREET

TERMS: Net Cash. PAYABLE IN NEW YORK EXCHANGE

2 drums of ANILINE OIL

45 - 1028 - 183 - 845
45 - 1037 - 207 - 830

1675 lbs. Net @ 35¢ per lb.	$586.25
DRUMS extra and returnable	50.00
	$636.25

~~636.25~~

Shipped to-

H. E. Winfield,
960 East 35th St.,
Brooklyn, N. Y.

ALL CLAIMS MUST BE MADE WITHIN TEN DAYS FROM RECEIPT OF GOODS.

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McKESSON & ROBBINS

NEW YORK, N.Y.

United States License
No. 24888
Food Administration

NE 16TH 1920 Your Order Salesman

M L WEISS
C/O A.C. WINFIELD
980 E 35TH ST.
BROOKLYN. N.Y.

Invoice Date
JUNE 16TH 1920
Book
615 029
Terms
C O D

Remarks

Payable in Gold or its equivalent, in NEW YORK or sight exchange.

UMS	CARBON BI_SULPHIDE	ABOUT 1000LBS	09	90.00
		2 DRUMS	15.00	30.00
				120.00

TO BE DELIVERED W THIN A WEEKS TIME.

MGM/

— Bills not paid within 30 days will be subject to draft with exchange on New York. We cannot guarantee the safe delivery of ...obtaining a receipt for same, as "Shipped in Good Order," we are not responsible for any damage or loss that may occur in transit... claims allowed unless date of our invoice is given. All claims must be made within 5 days after receipt of goods. Should you ...to refer to this invoice, please mention Book Number as given above.

...ense the merchandise entered herein manufactured by [illegible] to comply with the Federal Food and Drugs Act and Amendments thereto.

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IN THE UNITED STATES PATENT OFFICE.

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In re Application of : Division 15; Room 308.

MORRIS L. WEISS, : VULCANIZATION ACCELERATORS

filed November 12, 1921; :

Serial No. 514,727. :

- - - - - - - - - - - - - - -

AFFIDAVIT OF CHESTER FRANKENSTEIN.

State of New York,)
: ss.:
County of New York)

CHESTER FRANKENSTEIN, being duly sworn, deposes and and says as follows:

I am of mature age and am a resident of New York City, New York.

During the spring of 1920 I was emplyed as assistant chemist at the laboratories of the States Metals Corporatibn at 131 Harris Avenue, Long Island City.

On or about April 8, 1920, I assisted Mr. Henry S. Doty in conducting tests to determine the relative merits of diphenylguanidine as an accelerator of rubber vulcanization as compared with hexamethylene-tetramine, using therefor a sample of diphenlyguaindine which said Doty provided for that purpose. Said tests comprised the introduction of equal quantities of both of said materials into different batches of so-called "tread stock" and vulcanizing the same for equal periods of time. The results of said tests showed that diphenylguanidine was much superior to hexamethyltetramine in point of time required

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for vulcanization and in the qualities of the vulcanized product.

I also assisted said Doty in similar tests conducted at said place during the first part of June, 1920, and the results of the same were to the same effect as the previous tests. I have examined "Exhibit A" attached to the affidavit of Henry S. Doty and state of my own knowledge that said exhibit represents the results of said tests of June, 1920.

Chester Frankenstein

Sworn to and subscribed before
me this 27th day of January,
1922.

Walter S. Davies.
Notary Public,
New York Co.

Sig.3.

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COPY

"EXHIBIT C."

J.A.KENDALL
524 Second National Bldg.,

SUBJECT:

AKRON, OHIO, Aug.26,1920.

Racine Auto Tire Co.,
Racine, Wisc.

Gentlemen:-

Attention Mr. A. H. Brehm.

We are pleased to announce the placing of a new ACCELERATOR "STATES X-L-O" upon the market. This ACCELERATOR is a noteworthy addition to the widely known compounding ingredients manufactured by FRAZAR & CO. New York.

"STATES X-L-O" has the unique qualities of -

POWERFUL TENSILE STRENGTH -
20% Higher Tensile with Same Elongation as the best now on the market.
QUICK CURE
Vulcanization effected in 3/4 TIME of any Accelerator now produced.
NON-POISONOUS PROPERTIES
There is NO ODOR WHATEVER in curing room nor in FINISHED COMPOUNDS.
NO RASH nor SKIN TROUBLE ANNOYS WORKMEN.
DURABILITY
Has superior power on compounds in DURABILITY AND AGEING.
LOWEST PRICE COMPATIBLE WITH QUALITY.
$2.50 per lb., f.o.b. Brooklyn, N.Y.
IMMEDIATE SHIPPING FACILITIES.
Quantity production assures PROMPT DELIVERIES. "X-L-O" packed in approx. 100 lb. paper lined wooden barrels.

There is an enormous embryonic demand already created for this Accelerator, and we believe prompt action on your part will be rewarded by immediate saving in dollars and time.

Are these strong features of vital interest to your compounding staff? We believe that you cannot afford to miss this opportunity to investigate a new Accelerator.

We thank you heartily for your attention.

Yours very truly,
J.A.KENDALL.

CHH:M
LCT

177

COPY

EXHIBIT C (2)

.A.KENDALL
24 Second National Bldg.

SUBJECT:

AKRON, OHIO, Aug.26,1930

Brunswick-Balke-Collender Co.,
Muskegon, Mich.

Gentlemen:-

Attention Mr. A. Brill.

We are pleased to announce the placing of a new ACCELERATOR "STATES X-L-O" upon the market. This ACCELERATOR is a noteworthy addition to the widely known compounding ingredients manufactured by FRAZAR & CO., New York.

"STATES X-L-O" has the unique qualities of -

POWERFUL TENSILE STRENGTH
20% Higher Tensile with Same Elongation as the best now on the market.
QUICK CURE
Vulcanization effected in 3/4 TIME of any Accelerator now produced.
NON-POISONOUS PROPERTIES
There is NO ODOR WHATEVER in curing room nor in FINISHED COMPOUNDS.
NO RASH nor SKIN TROUBLE ANNOYS WORKMEN.
DURABILITY
Has superior power on compounds in DURABILITY AND AGEING.
LOWEST PRICE COMPATIBLE WITH QUALITY
$2.50 per lb., f.o.b. Brooklyn, N.Y.
IMMEDIATE SHIPPING FACILITIES
Quantity production assures PROMPT DELIVERIES. "X-L-O" packed in approx. 100 lb. paper lined wooden barrels.

There is an enormous embryonic demand already created for this Accelerator, and we believe prompt action on your part will be rewarded by immediate saving in dollars and time.

Are these strong features of vital interest to your compounding staff? We believe that you cannot afford to miss this opportunity to investigate a new Accelerator.

We thank you heartily for your attention.

Yours very truly,

178

GHH:M
LCT

J.A.KENDALL

886

COPY

EXHIBIT C

J.A.KENDALL
524 Second National Bldg.

SUBJECT:

AKRON, OHIO, Aug.26,192

The Mason Tire & Rubber Co.,
Kent, O.

Gentlemen:-

Attention Mr. C. D. Rockwood

We are pleased to announce the placing of a new ACCELERATOR "STATES X-L-O" upon the market. This ACCELERATOR is a noteworthy addition to the widely known compounding ingredients manufactured by FRAZAR & CO. New York.

"STATES X-L-O" has the unique qualities of -

POWERFUL TENSILE STRENGTH
20% Higher Tensile with Same Elongation as the best now on the market.
QUICK CURE
Vulcanization effected in 3/4 TIME of any Accelerator now produced.
NON-POISONOUS PROPERTIES
There is NO ODOR WHATEVER in curing room nor in FINISHED COMPOUNDS.
NO RASH nor SKIN TROUBLE ANNOYS WORKMEN.
DURABILITY
Has superior power on compounds in DURABILITY AND AGEING.
LOWEST PRICE COMPATIBLE WITH QUALITY
$2.50 per lb., f.o.b. Brooklyn,N.Y.
IMMEDIATE SHIPPING FACILITIES
Quantity production assures PROMPT DELIVERIES. "X-L-O" packed in approx. 100 lb. paper lined wooden barrels.

There is an enormous embryonic demand already created for this Accelerator, and we believe prompt action on your part will be rewarded by immediate saving in dollars and time.

Are these strong features of vital interest to your compounding staff? We believe that you cannot afford to miss this opportunity to investigate a new Accelerator.

We thank you heartily for your attention.

Yours very truly,

CHH:M
LCT

J.A.KENDALL.

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PURCHASE ORDER

NEW CASTLE RUBBER COMPANY

NEW CASTLE, PA.

J. A. Kendall,
524 -2d Nat'l. Ex. Bldg.,
Akron, Ohio.

IMPORTANT: ALL SHIPMENTS AND CORRESPONDENCE SHALL BE ADDRESSED TO OUR FACTORY
MANORINGTOWN, PA

THESE NUMBERS SHALL BE SHOWN ON ALL SHIPPING PAPERS, INVOICES AND RECEIPTED CORRESPONDENCE

ORDER NO. V4788

CLASSIFICATION: V L WE

REQUISITION NO. 9235

PLEASE ENTER OUR ORDER AS PER SPECIFICATIONS AND CONDITIONS HEREIN SET FORTH

DATE 8-302-0

ITEMS:	PRICE
1 lb. sample of "States X-L-O"	
Rush shipment.	
In accordance with your letter 8-26-20	
Kindly advise price by return mail.	MSB 7 - SEP

NOTE: ALL INVOICES MUST BE RENDERED IN DUPLICATE AND ONLY WHEN ACCOMPANIED BY ORIGINAL EXPRESS RECEIPT OR BILL OF LADING

ACCEPTANCE AND IN CONSIDERATION HEREOF THE VENDOR WARRANTS THAT THE ABOVE ARTICLES DO NOT INFRINGE ON ANY UNITED STATES PATENT, THAT HE WILL DEFEND ANY SUIT THAT MAY ARISE IN RESPECT THERETO, AND THAT HE WILL SAVE THE VENDEE HARMLESS FROM ANY LOSS WHICH MAY BE INCURRED BY THE ASSERTION OF ANY PATENT RIGHTS THEREIN.
ORDER MUST NOT BE FILLED AT HIGHER PRICES THAN LAST QUOTED OR CHARGED WITHOUT ADVICE.
ALLOW NO CHARGE FOR BOXING, PACKING OR CARTING UNLESS BY AGREEMENT.
RESERVE THE RIGHT TO CANCEL THIS ORDER OR ANY UNFILLED PORTION THEREOF IF DELIVERIES ARE NOT MADE AS SPECIFIED HEREIN.
NO LOCAL CHECK TO BE ACCEPTED IN PAYMENT WITHOUT DISCOUNT FOR COLLECTING.
IN THE EVENT OF FIRE, FLOOD, STRIKES, LOCKOUT, ACCIDENT, WAR OR OTHER CAUSES BEYOND OUR CONTROL INTERFERING WITH THE PRODUCTION OR THE TRANSPORTATION OF THE GOODS HEREIN DESCRIBED, DELIVERIES UNDER THIS ORDER MAY BE SUSPENDED DURING THE PERIOD REQUIRED TO REMOVE THE CAUSE.

TERMS	F.O.B.	SHIP VIA.
2-10-30		Parcel post

NEW CASTLE RUBBER COMPANY

CAM: VK

Purchasing Agent

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SE IN CENTER

#6

IN THE UNITED STATES PATENT OFFICE.

In re Application of	:	Division 15; Room 308.
MORRIS L. WEISS,	:	
Serial No. 514,727;	:	VULCANIZATION ACCELERATORS.
filed November 12, 1921.	:	

New York, January 30, 1922.

HON. COMMISSIONER OF PATENTS,

Washington, D. C.

Sir:-

Attached hereto is an additional affidavit of Van Lear Woodward which it is desired to submit as supplementary to the affidavits of Morris L. Weiss, Henry S. Doty, and Chester Frankenstein forwarded with the letter to the Patent Office of January 27, 1922. This affidavit is sent at this time in view of the fact that said Van Lear Woodward was away from the City of New York during the latter part of last week and was not available to execute the affidavit at that time.

Trusting that the application will receive prompt action for the reasons stated, we are

Very respectfully,

MORRIS L. WEISS,

By Sheffield & Betts
his Attorneys.

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COPY

IN THE UNITED STATES PATENT OFFICE.

- - - - - - - - - - - - - - - -

In re Application of : Division 15; Room 308.

MORRIS L. WEISS, :

Serial No. 514,727; : VULCANIZATION ACCELERATORS

filed November 12, 1921. :

- - - - - - - - - - - - - - -:-

AFFIDAVIT OF VAN LEAR WOODWARD.

STATE OF NEW YORK)
: ss.:
COUNTY OF NEW YORK)

VAN LEAR WOODWARD, being duly sworn, deposes and says as follows:

I am Vice President of the Dovan Chemical Corporation, assignee of the above entitled application.

On or about April 7, 1920, Morris L. Weiss, the above mentioned applicant, called at my office, No. 30 Church Street, New York City, and explained to myself and Henry S. Doty the invention set forth in said application. At said time and place said Weiss delivered to said Doty and myself a sample of diphenylguanidine and explained to me and said Doty the manner and method of using the same as an accelerator in the vulcanization of rubber articles. Thereupon said Doty agreed to make tests of said sample in the valcanization of rubber and on or about April 8, 1920, said tests were conducted by said Doty at the laboratories of the States Metals Company, of Long Island City, New York. Immediately there-

after I was advised by said Doty that said tests had proved entirely satisfactory and the results obtained therefrom, using the same as an accelerator in the vulcanization of rubber, were superior to the results obtained when using hexamethylene tetramine. In view of the results of said tests said Weiss, Doty and the deponent agreed to co-operate in the manufacture for the sale of diphenylguanidine as an accelerator. preparations were then made for the manufacture of the same in commercial quantities, and during the month of June, 1920, sufficient quantities of chemicals were purchased by said Weiss, Doty and the deponent to start the manufacture of said accelerator. I have examined the invoices attached to the affidavit of said Doty and marked "Exhibit B", and know them to be invoices for chemicals purchased as aforesaid.

About the middle of June, 1920, the deponent was shown the results of a series of tests made at the laboratories of said States Metals Company at Long Island City by said Doty using diphenylguanidine as an accelerator. I have examined "Exhibit A" attached to the affidavit of said Doty, and recognize the same as being a true report of said tests as I saw the same in June, 1920. Thereafter, from June 1920 to September 1920, about 150 pounds of diphenylguanidine were manufactured by at laboratories equipped for that purpose at 980 East 35th Street, Brooklyn, New York. I have examined copies of the letters attached to the affidavit of said Doty as "Exhibit C", and recognize the same as being true copies

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of letters sent out to various concerns manufacturing rubber goods advising them of the availability of diphenylguanidine as an accelerator for rubber vulcanization during the latter part of August, 1920, by our Akron agent or representative, J. A. Kendall. In "Exhibit C" references to "XLO" refer to the accelerator comprising diphenylguanidine as the active agent thereof. Beginning about the last week in August 1920 samples of the same were sent to various manufacturers of rubber goods, including the General Tire & Rubber Company, of Akron, Ohio, and the Goodyear Tire & Rubber Company, of Akron, Ohio, and others.

The sales of said accelerators were begun during September, 1920, and were made to various rubber manufacturing concerns, including the Dunlop Tire & Rubber Company of America, of Buffalo, New York, the Mason Tire & Rubber Company, of Kent, Ohio, the New Castle Rubber Company, of New Castle, Penna., and others.

I recognize "Exhibit D" attached to the affidavit of said Doty as an order for diphenylguanidine as an accelerator sent to us through said J. A. Kendall and received at our office on September 2, 1920.

I have read the affidavits of said M. L. Weiss and said Henry S. Doty and would state that the same are true in all respects to the best of my knowledge, information and belief.

Van Lear Woodward

Sworn to and subscribed before me this 30 day of January, 1922.

Edna L. Krieger

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M/MSY

ADDRESS ONLY THE COMMISSIONER OF PATENTS, WASHINGTON, D. C.

Div. 15 S-181 **Serial No.** 514,727

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Feb. fifteen, 1922

Morris L Weiss, Assor. etc.

Sir: Your APPLICATION for a patent for an IMPROVEMENT in Vulcanization Accelerators

filed Nov. 12, 1921, has been examined and ALLOWED. (12 claims)

The final fee, TWENTY DOLLARS, must be paid not later than SIX MONTHS from the date of this present notice of allowance. If the final fee be not paid within that period, the patent on this application will be withheld, unless renewed with an additional fee of $15, under the provisions of Section 4897, Revised Statutes.

The office delivers patents upon the day of their date, and on which their term begins to run. The printing, phbtolithographing, and engrossing of the several patent parts, preparatory to final signing and sealing, will require about four weeks, and such work will not be undertaken until after payment of the necessary fee.

When you send the final fee you will also send, DISTINCTLY AND PLAINLY WRITTEN, the name of the INVENTOR, TITLE OF INVENTION, AND SERIAL NUMBER AS ABOVE GIVEN, DATE OF ALLOWANCE (which is the date of this circular), DATE OF FILING, and, if assigned, the NAMES OF THE ASSIGNEES.

If you desire to have the patent issue to ASSIGNEES, an assignment containing a REQUEST to that effect, together with the FEE for recording the same, must be filed in this office on or before the date of payment of final fee.

After issue of the patent uncertified copies of the drawings and specifications may be purchased at the price of TEN CENTS EACH. The money should accompany the order. Postage stamps will not be received.

Final fees will NOT be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

Respectfully,

Thomas E. Robertson

Commissioner of Patents.

IN REMITTING THE FINAL FEE GIVE THE SERIAL NUMBER AT THE HEAD OF THIS NOTICE.

UNCERTIFIED CHECKS WILL NOT BE ACCEPTED.

Sheffield and Betts

52 William St.

New York, N.Y.

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893

20 /

1922 FEB 9 U.S.PAT.OFFICE

2—337.

MEMORANDUM
OF
FEE PAID AT UNITED STATES PATENT OFFICE.

(Be careful to give correct Serial No.)

Serial No. 514727, 19..

INVENTOR:
Morris L. Weiss

PATENT TO BE ISSUED TO
As per record.

NAME OF INVENTION, AS ALLOWED:
Valve mechanism Accelerator

DATE OF PAYMENT:
Feb. 17, 1922

FEE:
$20 Twenty

DATE OF FILING:
November 12, 1921

DATE OF CIRCULAR OF ALLOWANCE:
Feb. 15-1922

The Commissioner of Patents will please apply the accompanying fee as indicated above, on
[illegible] in the issue of March 7, 1922.

REMIT $ 20.00

Sheffield & Betts
Attorney.

[illegible] Div. B.
Feb. 20, 1922.

SEND PATENT TO
Sheffield & Betts
52 William St
New York, N.Y.

9—3885

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ADDRESS ONLY THE COMMISSIONER OF PATENTS, WASHINGTON, D. C.

2—74

DEPARTMENT OF THE INTERIOR.
UNITED STATES PATENT OFFICE.

Washington, D. C., Feb. 20, 1922, *192*

MORRIS L. WEISS, Assor.

Sir:

Your application for patent for an improvement in

Vulcanisation 'ccelerators,

*serial No.*514,727 *, allowed* Feb. 15, 1922

has been WITHDRAWN from the ISSUE FILES in this office. The reasons therefor will be communicated to you by the Examiner.

THE FINAL FEE WILL BE REFUNDED IN DUE COURSE OF BUSINESS.

Until a new notice of allowance is sent you the final fee will not be required.

Very respectfully,

T.E.Robertson

Commissioner of Patents.

Shaffield and Batts,
52 William Street,
New York,N.Y.

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5 Room 308 2-220 Paper No. 7

Address only "The Commissioner of Patents, Washington, D.C." and not any official by name.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON Feb. 23,1922

Sheffield & Betts

52 William st.

New York, N.Y.

Please find below a communication from the EXAMINER in charge of the application of

M.L.Weiss,Ser.No.514,727,filed Nov. 12,1921; Vulcanization Accelerators.

Thomas E. Robertson
Commissioner of Patents

This application allowed Feb.15,1922 has been withdrawn from issue . Feb.20,1922 for the reason that the following new reference may be applied to the claim : Journal of Industrial and Engineering Chemistry Vol.XII No.4 page 317,— 322 filed in U.S.Patent Office April 5 1920 Published by the American Chemical Society. The claims are rejected on said publication on page 322 Experimental Part - a method is stated for testing accelerator- on some Page Table I discloses Diphenylguanidine as one of those tested. On page 319 first paragraph - line 6 the conclusions of the authers are stated as to diphenylguanidine.

Applicant discloseses of the use of said accelerator are not more specific than disclosed in the publication, hence the rejection in as much as applicants affidavit under Rule 75 shows no completion of the invention prior to Apr. 5,1920 but merely conception.

M.L. Rearson
Examiner.

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ADDRESS ONLY THE COMMISSIONER OF PATENTS WASHINGTON, D. C.

Letters No.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Feb. 20,1922

Hon. Commissioner of Patents

It is respectfully requested that application of Morris L Weiss Ser. No.514,727 filed Nov. 12,1921 allowed Feb.14,1922 be withdrawn from issue (final fees having been paid) for the purpose of rejecting the claims on a newly discovered reference- a publication "Journal of Industrial and Engineering Chemistry Vol XII No.4. page 317 -322. This publication was filed in the Office on April 5, 1920 - as evidenced by the library stamp on page 313 of the above volume.

In a prior rejection on another publication applicant under Rule 75 overcame the date Sept. 6,1920 and states that he conceived the invention prior to Jan. 1,1920. (affidavit of applicant Morris L Weiss filed Jan. 28,1922 paper No.5 and further states that on April 7,1920 he disclosed the invention to others and that it was tried and reduced to practice about April 8,1920. The reference on which the Examiner now desires to reject the claims was as stated above filed in the Office on April 5,1920. This reference is a publication by the American chemical Society of an address alleged to have been presented before the Rubber section at the 58th meeting of the American Chemical Society., Phila, Pa Sept. 2 - 6 1919 . Said publication

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alleges that the substance Diphenylguanidine had been tested as an accelerator page 319 line 23-25 and on Page 322 it mentions Diphenylguandine Table 1, as one of the substances that had been tested in the preliminary experiments which the authors of the article conducted. But it is stated on same page 322 after Table II -.

"As these preliminary test were conducted solely for guidance in subsequent experiments. we do not feel warranted in drawing extensive conclusions from them"

The publication is a clear disclosure of the use of di and And triphenylguanidine as an accelerator broadly, and as applicant's specification is no more than a broad disclosure of the use of the same reagent without disclosing any details other than that usually employed with accelerators of this class, it is considered that the publication constitutes a reference for the claims.

Carl Thuring

Respectfully

M. L. Redron,

Examiner, Div. 15.

Feb. 20/22

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JAMES R. SHEFFIELD
L. P. H. BETTS
JOHN W. PETERS
JAMES J. CORGROVE
EDWARD W. VAILL
ABEL E. BLACKMAR, JR.

SHEFFIELD & BETTS
COUNSELLORS AT LAW
52 WILLIAM STREET
NEW YORK

SAMUEL R. BETTS
COUNSEL

February 23, 1922

Hon. Commissioner of Patents
Washington, D. C.

Re Application of Morris L. Weiss
Serial No. 514,727
Filed November 12, 1921.
Allowed February 15, 1922.
Withdrawn from Issue Feb. 20, 1922.

Attention of the Financial Clerk

Dear Sir:

We are in receipt of the notice dated February 20, 1922, advising us of the withdrawal of the above mentioned application from the issue files of the Patent Office. We also note that "the final fee will be refunded in due course of business".

In view of the expected early reallowance of this application, we desire to request that this final fee be held subject to our order and instructions in connection with the reallowance of this application. It may be possible that we shall desire to telegraph you to apply this final fee to the same application immediately upon reallowance, which we trust can be done by telegram.

Yours respectfully,

Sheffield & Betts

SWV/K

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(889)

SHEFFIELD & BETTS
COUNSELLORS AT LAW
52 WILLIAM STREET
NEW YORK

SAMUEL R. BETTS
COUNSEL

February 24, 1922

#9½

Hon. Commissioner of Patents
Washington, D. C.

Attention of Chief of Issue Division

Re Application of M. L. Weiss, Ser. #514,727
Filed Nov.12,1921,-Vulcanization Accelerators

S i r :

Please advise Messrs. Milans & Milans of #908 G St., N. W,, Washington, immediately upon the reallowance of the above entitled application.

Sheffield & Betts.
Attorneys for M. L. Weiss

EWV/K

IN THE UNITED STATES PATENT OFFICE

In re Application of	
MORRIS L. WEISS	
Serial No. 514,727	Div. 15 - Room 308
Filed November 12, 1921	
VULCANIZATION ACCELERATORS	

New York, February 24, 1922

HONORABLE COMMISSIONER OF PATENTS

Washington, D. C.

S i r :

In response to the official action of February 23, 1922, resulting from the withdrawal of the above entitled case from the Issue Division on February 20, 1922, the accompanying affidavits of Morris L. Weiss, Monroe H. Daniels, Harvey W. Seil, Isidor Greenwald and Reuben Schulich, are submitted under Rule 75 in order to overcome the publication in the Journal of Industrial and Engineering Chemistry, page 317, vol. 12, of 1920.

These affidavits also antedate September 2, 1919, the date alleged in the publication as being that upon which the authors read papers at the Philadelphia meeting of the American Chemical Society.

This inventor is undoubtedly the pioneer in the art relative to the substance claimed in this specification as an accelerator and evidence of earlier dates still than those now alleged might be obtained but earlier dates

are thought not to be necessary at this time since only sufficient evidence to overcome the references cited by the Patent Office is now required. In view of the unexpected delay which has been caused in this case by the discovery of the publication last cited, it is requested that the application be taken up for action immediately and passed to issue at the earliest possible moment.

Very respectfully,

MORRIS L. WEISS

by his Attorneys

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IN THE UNITED STATES PATENT OFFICE

- - - - - - - - - - - - - -

In re Application of :

MORRIS L. WEISS, :

Serial No.514,727 : Div. 15 - Room 308

Filed Nov. 12, 1921 :

VULCANIZATION ACCELER- :

ATORS. :

- - - - - - - - - - - - - -

STATE OF NEW YORK,)
: ss.:
COUNTY OF NEW YORK)

MORRIS L. WEISS, being duly sworn, depeses and says as follows:

I am the Morris L. Weiss named in the above entitled application.

During the year 1919 I was employed by the Republic Rubber Company located at Youngstown, Ohio, as research chemist under Monroe H. Daniels, who was chief chemist for said Company. Prior to January 1, 1919, I conceived the possibilities of using diphenylguanidine as an accelerator in the vulcanization of rubber compounds and after disclosing the same to said Daniels I proceeded with the production and test of said diphenylguanidine as accelerator. Said accelerator was produced and actually used in the vulcanization of rubber goods during the early part of the year 1919. During the month of March, 1919, at a meeting of the Youngstown Chemical Society, I had a

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conversation with Harvey A. Neil and disclosed to him my invention, including the fact of my previous production and use of diphenylguanidine as an accelerator for vulcanizing rubber compounds.

During the Spring of the year 1919 I wrote to Dr. Isidor Greenwald, my former chief chemist at the Harriman Research Laboratory of New York, who was then a Lieutenant in the Sanitary Corps U. S. Army, located at Camp Mead, Maryland, and advised him that I had produced and used diphenylguanidine as an accelerator for rubber vulcanization and that if he so desired I would send him a sample for use in his research work. He replied that owing to his duties at that time he was unable to use the material.

During the last week of March, 1920, I went to New York and prior to the first of April, 1920, I called at the office of Messrs. Doty & Woodward, and thereafter during the first week of April, 1920, delivered to them a sample of diphenylguanidine as set forth in my prior affidavit executed January 27, 1922.

Morris L. Weiss

Subscribed and sworn to before
me this 24th day of February, 1922.

Walter S. Jones
Notary Public,
New York County.

904

IN THE UNITED STATES PATENT OFFICE

In re Application of

MORRIS L. WEISS

Serial No. 514,727 Div. 15 - Room 300

Filed November 12, 1921

VULCANIZATION ACCELERATORS

New York, February 1922

STATE OF NEW YORK)
(SS:
COUNTY OF NEW YORK)

HARVEY A. SEIL, being duly sworn, deposes and says as follows:

I am of mature age and a resident of Rutherford, New Jersey; I am a chemist by profession and conduct a chemical Laboratory at 128 Water Street, New York City, N. Y.

During the year 1919, I was chief chemist for the Youngstown Chemical Company at Youngstown, Ohio. Prior to the month of April, 1919, I met Morris L. Weiss at a meeting of the Chemical Society in Youngstown, Ohio, at which meeting I read a paper. I then and there had a talk with said Weiss about accelerators for rubber compounds, during which said Weiss told me that he had been working on the production of diphenylguanidine as an accelerator for vulcanizing rubber compounds and that said substance had proved to be very efficient for that purpose.

Harvey A. Seil.

Sworn to and subscribed before
me this 23 day of February, 1922.

Walter S. Jones Notary Public
New York Co

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IN THE UNITED STATES PATENT OFFICE

- - - - - - - - - - - - - -

In re Application of :

MORRIS L. WEISS, : Division 15; Room 306.

Serial No. 514,727; :

filed Nov. 12, 1921; :

VULCANIZATION ACCELERATORS :

- - - - - - - - - - - - - -

STATE OF NEW YORK)
: ss.:
COUNTY OF NEW YORK)

ISIDOR GREENWALD, being duly sworn, deposes and says as follows:

I am of mature age and a research chemist employed at the Harriman Research Laboratory, 59th Street and Ninth Avenue, Borough of Manhattan, City, County and State of New York.

Mr. Morris L. Weiss has been known to me for about ten years and for four years acted as my assistant. He became acquainted with some of the work I was doing and in which I did some work with methylguanidine. His association with my work ended about the year 1916.

I was in the U. S. Army from December 1917 to May 1919. From October 26, 1918, to May 6, 1919, I was stationed at Camp Mead, Maryland, as Lieutenant, Sanitary Corps. During my duty at this Camp I received a letter from Morris L. Weiss at Youngstown, Ohio, offering me a sample of diphenylguanidine for experimental work, he having stated that said substance had been produced

by him for use in the acceleration of the vulcanization of rubber compounds. Not being able at that time to continue my researches, nor being specifically interested in that class of guanidines, I wrote to him declining his offer.

Sidon Greenwald

Sworn to before me this
24th day of Febuayy,
1922.

Walter S. Jones
Notary Public,
New York Co.

907

IN THE UNITED STATES PATENT OFFICE

In re Application of

MORRIS L. WEISS

Serial No. 514,727 — Div. 15 - Room 308

Filed November 12, 1921

VULCANIZATION ACCELERATORS

New York, February 2nd 1922.

STATE OF NEW YORK)
(SS:
COUNTY OF NEW YORK)

REUBEN SCHULICH, being duly sworn, deposes and says as follows:

I am of mature age and a resident of the Borough of Bronx, City, County and State of New York; during the years 1919 and 1920, I resided at Youngstown, Ohio, prior to which time I had become acquainted with Morris L. Weiss, whom I knew as a rubber chemist. About the middle of March, 1920, I called at the residence of Morris L. Weiss, at Youngstown, Ohio, and then and there discussed with him accelerators for rubber vulcanization and which discussion related to guanidines, including diphenylguanidine , which latter, said Weiss told me, he had previously produced and used as an accelerator for the vulcanization of rubber goods. The month of March is fixed in the mind of deponent by reason of the fact that during the month of January, 1920, deponent was ill with an attack of

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influenza and subsequent to March 1, 1920, for several weeks, was not regularly employed as a chemist. During this period of unemployment deponent visited the residence of Morris L. Weiss and the conversation above referred to took place.

Reuben Schulick.

Sworn to before me this
23rd day of February, 1922.

Walter S. Jones.
Notary Public
New York Co.

IN THE UNITED STATES PATENT OFFICE.

- - - - - - - - - - - - -

In re Application of :

MORRIS L. WEISS, : Division 15; Room 308.

Serial No. 514,727; :

filed Nov. 12, 1921; :

VULCANIZATION ACCELERATORS. :

- - - - - - - - - - - - -

STATE OF PENNSYLVANIA, :

: ss.:

County of :

MONROE H. DANIELS, being duly sworn, deposes and says as follows:

I am of mature age and reside at Youngstown, Ohio.

During the year 1919 I was chief chemist of the Republic Rubber Company at Youngstown, Ohio. During that year Morris L. Weiss was employed as research chemist in my department in connection with the development of accelerators for rubber compounds. During the early part of the year 1919 said Weiss produced diphenylguanidine as an accelerator for rubber compounds, and during the early part of that year made numerour tests of the same as an accelerator in vulcanizing rubber. These tests were also carried out in the compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to

be highly efficient as an accelerator in the actual vulcanization of rubber goods, such as hose, tires, belts, valves and other mechanical goods.

Thomas A. Davies

Sworn to and subscribed
before me this 25th day
of February, 1922.

Fay C. Miller
Notary Public,
County.

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911

February 28, 1922. #10

Messrs. Sheffield & Betts,
52 William Street,
New York,N. Y.

Gentlemen:

Referring to your communication of the 23rd inst., relative to withholding the final fee in the application of Morris L. Weiss, Serial No. 514,727, you are advised that your request will be granted.

Respectfully,

Wm. I. Wyman,
Chief Clerk.

912

20-

8.

B—272.

MEMORANDUM

OF

FEE PAID AT UNITED STATES PATENT OFFICE.

(Be careful to give correct Serial No.)

Serial No. 514727, 19...

INVENTOR:

Morris L. Weiss

PATENT TO BE ISSUED TO

as per record

NAME OF INVENTION, AS ALLOWED:

Vulcanization Accelerator

DATE OF PAYMENT:

March 1-1922

FEE:

$20- Twenty

DATE OF FILING:

November 12-1921

DATE OF CIRCULAR OF ALLOWANCE:

March 1-1922

The Commissioner of Patents will please apply the accompanying fee as indicated above.

REMIT $20.00

P.M.M.

Chief Issue Div.

Sheffield & Betts

Attorney.

March 18,19222

SEND PATENT TO

Sheffield & Betts

52- William St.

New York, N.Y.

B—1788

Duplicate fee

205

913

ADDRESS ONLY THE COMMISSIONER OF PAT. WASHINGTON, D. C.

H/MWY
Div.15 2-182

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

Serial No.
514,727

Mar. one, 1922

Morris L Weiss, Assor. etc.
c/o Sheffield and Betts
52 William St.
New York, N.Y.

Sir:

Your APPLICATION for a patent for an IMPROVEMENT

Vulcanization Accelerators

filed Nov. 12, , 1921, has been examined and ALLOWED. (12 clms)

The final fee, TWENTY DOLLARS, having been received, the Letters Patent will be forwarded in due course of business.

Additional copies of specifications and drawings will be charged for at the following rates: Single copies, uncertified 10 CENTS EACH. The money should accompany the order.

Respectfully,

Wm. D. Hyman

Chief Clerk.

206

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SHEFFIELD & BETTS
COUNSELLORS AT LAW
52 WILLIAM STREET
New York

SAMUEL R. BETTS
COUNSEL

March 3, 1922

B

Hon, Commissioner of Patents
Washington, D. C.

Attention of William I. Wyman
Re Application of Morris L. Weiss,
Serial No. 514,727

S i r :

Replying to your favor of the 28th ult., just received, we would say that the final fee on this application has been paid by the deposit of another $20. in view of the fact that we did not receive the reply to our letter of the 23rd in time. We will, therefore, have to ask you to kindly refund the previous fee referred to in your letter of the 28th ult.

Yours very truly,

Sheffield & Betts.

SWV/K

207

March 18, 1922.

Messrs. Sheffield and Betts,
52 William Street,
New York, N. Y.

Gentlemen:

Referring to your communication of recent date transmitting the final fee of $20.00 in the application of Morris L. Weiss, exor. Serial No. 514,727, you are advised that this fee is a DUPLICATE FINAL FEE and will be refunded in due course of business.

Letters Patent will be granted March 28, 1922 and will be forwarded to you at the above address.

Respectfully,

Wm. I. Wyman,
Chief Clerk.

Sig. 5.

916

United States District Court

Southern DISTRICT OF New York

HONORABLE COMMISSIONER OF PATENTS,
Washington, D. C.

SIR:

In compliance with the Act of February 18, 1922 (41 Stat. L. ....), you are advised that there was filed on the 29 day of May, 1922, in this court an action, suit, or proceeding No. E-24-23, entitled:

Name Donovan Chemical Corporation, Plaintiff,
Address Brooklyn, NY

versus

Name National Aniline & Chemical Company, Inc., Defendant,
Address New York City

brought upon the following patents:

	PATENT NO.	DATE OF PATENT	PATENTEE
1	1 411 231	March 28 1922	Morris L. Haas
2			
3			
4			
5			

In the above-entitled case, on the ..... day of ....., 192 the following patents have been included by ..... (insert amendment, answer, cross bill, or other pleading):

	PATENT NO.	DATE OF PATENT	PATENTEE
1			
2	Def. No. 12		
3			
4			
5			

In the above-entitled case the following decision has been rendered or decree issued:

In witness whereof I have affixed my hand this 24th day of November, 1922, at New York NY

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Clerk of said Court.

United States District Court

Southern DISTRICT OF New York

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HONORABLE COMMISSIONER OF PATENTS,
Washington, D. C.

SIR:

In compliance with the Act of February 18, 1922 (41 Stat. L. ....), you are advised that there was filed on the 29th day of May, 1922, in this court an action, suit, or proceeding No. E-11-23, entitled:

Name Doran Chemical Corporation, Plaintiff,
Address State of Delaware

Name National Oildraw Chemical Company Inc. Defendant,
Address Jersey City, N.J.

brought upon the following patents:

PATENT NO.	DATE OF PATENT	PATENTEE
1. 1411231	March 28 1922	Doran Chemical Corporation
2.		
3.		
4.		
5.		

In the above-entitled case, on the ..... day of ....., 192 the following patents have been included by ..... (insert amendment, answer, cross bill, or other pleading):

PATENT NO.	DATE OF PATENT	PATENTEE
1.		
2. See No. 11		
3.		
4.		
5.		

In the above-entitled case the following decision has been rendered or decree issued:

By Manton, Judge, interlocutory decree sustaining said patent, adjudging that defendants had infringed upon said patent, and granting perpetual injunction restraining defendant. Filed Feb. 21 1923.

In witness whereof I have affixed my hand this 23d day of April, 1923, at New York, N.Y.

Clerk.

By Manton, Judge, order suspending injunction pending appeal to the Circuit Court of Appeals. Filed Feb 23 1923

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1921

CONTENTS:

1. Application ____ papers.
2. Re: Dec 29, 1921
3. Catch & Affs. Jan 6, 1922
4. Pet Jan 13, 1922
5. Affs & Print Jan 28, 1922
6. Affs Jan 31, 1922
7. Letter Feb 20, 1922
8. Letter of Withdrawal Issue, Febr 24, 1922
9. Letter Feb 24 1922
10. Letter (C) Feb 25, 1922
11. Notice of Suit, Nov. 28-29
12. Decree of Suit, April 4-23
13. ____
14. ____
15. ____
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919

ter is removed. The crucible and contents are dried and weighed. The next step is acetylation with acetic anhydride, after which the cellulose acetate is removed by washing with acetone. Cellulose is determined by difference.

The Variability of Crude Rubber, JOHN B. TUTTLE.—This paper consisted chiefly of a résumé of previous work by Eaton and Granthan, de Vries and others. This is a subject on which not a great deal of work has been done in this country.

The Action of Accelerators During Vulcanization, J. H. SCOTT.—Detailed experiments by Spence and the author were described. These consisted of the introduction as dry powder of various alkaline substances, such as NaOH, Na_2CO_3, $Ba(OH)_2$, soda lime and MgO; dipping in alkaline solutions; and the washing of rubber with caustic.

Considerable reduction in the period of vulcanization was shown by all alkalis tried. Zinc oxide was found to be an aid, while barytes was without effect. In addition the physical properties of the stocks were improved. Washing with alkali gave slightly improved physical properties but no decrease in time of vulcanization. Immersion in 5 per cent NaOH solution for 24 hr. produced a slightly shorter cure with a little higher tensile strength.

The author pointed out that alkalis are not satisfactory accelerators, due probably to the bad aging properties of the compounds. The fact that they are accelerators is of considerable theoretical interest. They probably function by the hydrolysis of the nitrogenous matter of crude rubber to amino acids, which are powerful accelerators, comparing favorably with piperidine.

Mr. Scott defined the ideal accelerator as one capable of bringing about vulcanization in the shortest possible time consistent with factory practice and which produces maximum polymerization. It should also be nonpoisonous and easily handled. For some time it has been recognized by rubber chemists that accelerators have another effect than merely decreasing time of cure. The increase in tensile strength, snap, feel and nerve the author attributes largely to polymerization.

The Action of Certain Organic Accelerators in the Vulcanization of Rubber, C. D. KRATZ, A. H. FLOWER and COLE COOLIDGE.—This paper consisted of a review of experiments with aniline, urea, thiourea, mono-, di- and tri-phenyl thiourea and mono-, di- and tri-phenyl guanidine, anhydro formaldehyde aniline and paraphenylene diamine. The authors attribute the curing power of these accelerators to their decomposition at the temperature of vulcanization in the presence of sulphur-giving aniline, which they claim has a grouping which readily functions as a sulphur carrier. They recommend comparing accelerators in molecular quantities.

Reactions of Accelerators During Vulcanization, C. W. BEDFORD and WINFIELD SCOTT.—This paper is a reply to and a criticism of a recent paper by Dubosc in the *India Rubber World*. The authors stated that hexamethylene tetramine decomposes when heated with sulphur at the curing temperature and gives off CS_2, NH_3 and H_2S, but no acetylene, as claimed by Dubosc. They also stated that methylene aniline decomposes when heated under similar conditions, giving CS_2, aniline and thiocarbanilide.

The Effect of Organic Accelerators on the Vulcanization Coefficient, D. F. CRANOR.—The author gave in detail the results of experiments with hexamethylene-tetramine and the addition product similar to thiocarbanilide produced by the action of CS_2 on dimethylamine. He showed that the coefficient of vulcanization bears no direct relation to the physical properties. He obtained a technical cure with the dimethylamine addition product when the coefficient of vulcanization was aproximately 1.00. This falls in line with Scott's statement regarding the polymerizing influence of accelerators. Dimethylamine-dimethyl-dithiocarbamate is an extremely powerful accelerator. One-half per cent brings about a cure in 5 min. at 40 lb. steam.

Some Methods of Testing the Hardness of Vulcanized Rubber, H. P. GURNEY.—This paper consisted of a review of the different methods of determining hardness of rubber goods and contained data on the Shore hardometer and the Pusey-Jones plastometer.

The Manufacture and Use of Crimson Antimony, J. M. BIEBER.—The author gave a detailed description of the preparation of crimson antimony, i.e., antimony oxysulphide. The important points on the preparation are purely of antimony trichloride solution, and the concentration of the acid used for precipitation.

Research on Zinc Products for the Rubber Industry, P. R. CROLL and I. R. RUBY.—It was pointed out that the New Jersey Zinc Co. is very desirous of improving the quality of its zinc oxide for the rubber industry and has installed a rubber division in its new research laboratory for this purpose. Lantern slides showing the ultimate particles of zinc oxide were exhibited. Zinc oxide is crystalline and the particles vary in size from 0.1 to 1 micron, the average being 0.5 micron. Their microscopic work is excellent and is fundamental to an understanding of compounding phenomena.

Carbon Black—Its Properties and Uses, ST. J. PERROTT.—This paper was delivered in the Division of Industrial Chemists and Chemical Engineers and proved so interesting that Chairman Tuttle invited Mr. Perrott to give it also before the rubber division. The manner of producing gas black by incomplete combustion of natural gas, allowing the smoky flame to strike a cold metal surface (air cooled) was illustrated by lantern slides. From the black cloud issuing above the plant shown, one would gather that technique of this industry is not very highly developed. Mr. Perrott showed several slides of micro-photographs of gas black and stated that the particles varied in size from 30 to 100 milli-microns.

The paper of H. E. SIMMONS on the value of a library to the rubber laboratory was not given, but will be published soon. Owing to the absence of GEORGE OENSLAGER his paper on the testing of pigments was held over until the next meeting of the Rubber Division. The paper of C. OLIN NORTH on the effect of compounding ingredients on the physical properties of rubber was unfortunately not in final shape for presentation, but will doubtless be given at the next meeting of the division.

ELECTION OF OFFICERS

The officers elected for the coming year are Dr. WARREN K. LEWIS, chairman; and ARNOLD H. SMITH, secretary. Dr. Lewis is a well known member of the chemical engineering staff of Massachusetts Institute

Defendant's Exhibit K 212

Rubber Vulcanization Accelerators

BY ANDREW H. KING

This is a subject now attracting considerable attention in the rubber business. The possibilities seem almost unlimited. For example, a factory which has been using the old, well-known mineral accelerators can materially increase its capacity by the use of some one or more of the new organic catalysers, such as piperidine or para-phenylenediamine.

It is common knowledge that the degree of vulcanization can be greatly influenced by a change in either time or temperature. Thus a stock which cures ordinarily in 40 minutes at 40 lb. steam pressure can be vulcanized in 25 minutes at 60 lb. This is one way to speed up production. However, the increase in working steam pressure is expensive, and sometimes quite unsatisfactory. It is far better to add from 1 to 2 per cent of some good accelerator, and properly cure the rubber at low pressure, than to run chances of injuring the nerve by high temperature. In certain instances both high temperatures and accelerators are used, as in the case of cheap molded goods, where a large production is necessary to take care of the overhead.

An accelerator is merely a catalyser. It tends to increase the velocity of the reaction between sulfur and rubber during vulcanization. For the sake of clearness, I will enumerate a few conclusions deduced from numerous observations of the catalytic effect, sometimes called "the laws of catalysis":

1. The catalyser has the same chemical composition at the end of the reaction as it had in the beginning. This statement applies to nearly all accelerators, except certain of the organic compounds which are decomposed to a more or less extent at the temperature of vulcanization.

2. A catalytic agent is incapable of starting a reaction. It can only modify the velocity.

3. Very small quantities are sufficient to transform relatively large amounts of reacting substances.

4. The final state of equilibrium is independent of the nature and quantity of a catalyst.

5. Catalysers are of two kinds—positive and negative; i.e., they may either increase or retard the reaction velocity.

The above statements are based on observed facts. Just why they are so, and what the underlying principle of catalysis is, the future may explain. There are numerous theories which seem to fit separate cases quite well. Thus, the theory of surface concentration seems an excellent explanation of the behavior of platinum sponge in the contact process for sulfuric acid.

But the separate group of vulcanization accelerators seem to belong to the intermediate product family. It is thought that the catalyser unites with one of the reacting substances, forming an unstable compound, which in turn reacts with the other substance. In the course of this reaction, the catalyser is set free, and the process begins all over again.

An example of this phenomenon, though not a catalytic action in the true sense, is found in the commercial method for the preparation of aniline. Nitrobenzole is reduced by means of iron filings and hydrochloric acid. Only about one-fortieth of the theoretical quantity of acid is necessary. This is probably because iron filings and water are able to effect the reduction in the presence of ferrous chloride. In this instance it may be called a pseudo-catalyser. The reactions taking place are sometimes written as follows:

(1) $C_6H_5NO_2 + 3Fe + 6HCl \rightleftarrows 3FeCl_2 + 2H_2O + C_6H_5NH_2$

(2) $FeCl_2 + 2C_6H_5NH_2 + 2H_2O \rightleftarrows Fe(OH)_2 + 2C_6H_5NH_2.HCl$

(3) $2C_6H_5NH_2.HCl + Fe \rightleftarrows FeCl_2 + H_2 + 2C_6H_5NH_2$

(4) $C_6H_5NO_2 + 3H_2 \rightleftarrows C_6H_5NH_2 + 2H_2O$.

The halogen carriers, which are so important in organic preparations, are also pseudo-catalysers.

The chemical reaction between sulfur and rubber may be written:

Sulfur + Rubber ⇄ Polyprene Sulfide.

The speed of this reaction is influenced in proportion to the quantity of accelerator used, up to a certain limit, beyond which it acts as a retarder; that is, as a negative catalyser. As a general rule, accelerators should be used in small amounts, so as not to affect the nerve or quality of the rubber.

A peculiar fact has been noted. By a combination of accelerators the resulting increase in speed is greater than the sum of their individual increases, when acting alone. For example, the effect of 1 per cent tetramethylenediamine and 1 per cent piperidine exceeds the sum of the effects of the same catalysers when mixed in separate batches.

MINERAL ACCELERATORS

The chief mineral accelerators are:

Lime
Magnesia
Litharge
White lead
Zinc oxide

They are named in the order of their relative power.

Lime: The lime in common use is prepared by burning limestone and slacking the product by means of steam. Properly prepared, it is just a little short of complete hydration. In curing soft rubber from ½ to 2½ per cent may be used. For hard rubber larger amounts are customary.

Magnesia: The best magnesia is a heavy calcined product known as "Magnesia Usta." It is prepared by precipitating magnesium from solution in the form of magnesium carbonate and calcining the product. Magnesia finds a larger use than lime, though its curing action is only about half as great. Its advantage is that it leaves the nerve of the rubber absolutely unaffected, while lime has a slight hardening action. Combined with litharge it produces very satisfactory results.

Litharge and other lead compounds: Besides litharge, such compounds as white lead, sublimed white lead, and red lead are also valuable. Their use is limited, however, to black goods, and to those having high specific gravities. Stevens (*J. Soc. Chem. Ind.*, 34, 524-6, 1915) is of the opinion that the catalytic effect of litharge is due to the heat liberated by the following reaction:

$4PbO + 2S \rightleftarrows 3PbS + PbSO_4$

This action is proportional to the quantity present, so long as there is sufficient sulfur available to properly cure the rubber, and to convert the litharge to lead sulfide and sulfate. About 1 per cent sulfur is required for every 7 per cent of litharge. At the point where the rubber is fully cured the free sulfur drops, but is never completely absent. Large amounts of litharge serve to prevent "blooming"; i.e., the coming to the surface of colloidal free sulfur in the form of a gray scum.

Red lead is more active than litharge, but should never be used because of its oxidizing tendency. White lead, that is basic lead carbonate, is also an accelerator. Compared with litharge it has a much lower specific gravity and considerable toughening action. Sublimed white lead has the following average composition:

$PbSO_4$	78.5%
PbO	16.
ZnO	5.5

Defendant's Exhibit L (Page 1)

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It has only slight curing action, but is also a good toughener.

Zinc oxide: This has but little accelerating power. As a toughener it surpasses all of the lead fillers, and is only exceeded in this respect by lamp black. Because of its slight catalytic effect, considerable quantities can be used without retarding the cure.

Miscellaneous: Some oxides have a catalytic action under special circumstances. Thus, iron oxide (3 to 8 per cent) is quite useful in batches containing brown substitute.

Golden antimony sulfide also finds considerable use. It has but small catalytic value. Its action is due mainly to free sulfur, which the technical product always contains.

Manganese oxide, MnO, and cuprous oxide, Cu_2O, are both good accelerators, but because of their marked oxidizing tendencies they cannot be used. In fact, as a general rule copper and manganese, in any form, must be kept out of rubber if the product is to be anything but worthless.

Molybdenum sesqui-oxide over 10 per cent and alkali over 3 per cent are negative accelerators. The behavior of alkali is especially interesting, owing to the extensive use of alkali shoddies. Up to ½ per cent it acts as an accelerator. Beyond this it retards, and at 5 per cent it is almost impossible to effect a cure. Nickel oxide is a negative accelerator, and vulcanization can be entirely prevented by its use.

ORGANIC ACCELERATORS

The use of organic accelerators dates from the discovery of synthetic rubber. This product cannot be vulcanized without the addition of some of the organic catalysers. On the substitution of natural for synthetic rubber equally successful results were obtained.

The trouble with synthetic rubber, and for a time with the plantation variety, was excessive cleanliness. They secured the rubber hydrocarbon, but certain so-called impurities, which Mother Nature places in the rubber latex, were carefully excluded. Para rubber, by the Amazon method of coagulation, contains all the elements of the latex evenly distributed throughout the mass. For this very reason it is still true that no rubber is the equal of "Highlands Fine Para.

The catalysers present in rubber latex are thought to be related to the proteins, perhaps decomposition products. All organic accelerators are nitrogen bearing, and many have amino groups. The function of the nitrogen seems very important. So far there are only two generalizations possible:

1. According to Ditmar, all organic bases having dissociation constants greater than 10^{-6} act as accelerators, irrespective of constitution.

2. At present only nitrogen bearing compounds are known as accelerators, and it seems that this element must be a necessity.

From a mechanical standpoint a catalyzer is most conveniently mixed when it has the following properties:

It should be a solid, capable of being very finely pulverized.

It should have a high boiling point, so as not to be vaporized during vulcanization. Such behavior would cause a spongy appearance; that is, "blowing."

For convenience I will classify the most important organic accelerators under the following heads:

1. Carbon bisulfide addition products with
   - (a) Aniline
   - (b) Dimethyl aniline
   - (c) Tetrahydropyrrole
   - (d) Dimethylamine
2. Ammonium compounds
   - (a) Ammonium borate
   - (b) Aldehyde ammonia
   - (c) Quaternary ammonium bases
3. Amino compounds
   - (a) Para-phenylenediamine
   - (b) Tetramythylenediamine
   - (c) Sodium amide
   - (d) Naphthylene diamine
   - (e) BB Dimethyl Δ methyltrimethyleneimine
   - (f) Trimethyleneamine
   - (g) Benzylamine
4. Piperidine and derivatives
   - (a) Piperidine
   - (b) Methyl piperidine
5. Quinoline and derivatives
   - (a) Quinoline
   - (b) Quinoline sulfate
   - (c) Quinosol
   - (d) Sulfuroxyquinoline
6. Miscellaneous
   - (a) Anthraquinone
   - (b) Urea derivatives
   - (c) Formanilides

CARBON BISULFIDE ADDITION PRODUCTS

With Aniline: One of the oldest accelerators known in this country is diphenylthiourea, or thiocarbanilide,

$$\begin{matrix} & \diagup NH.C_6H_5 \\ C & = S \\ & \diagdown NH.C_6H_5 \end{matrix}$$

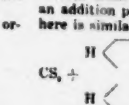
This substance may be prepared according to Gattermann as follows:

A mixture of 40 parts aniline, 50 parts carbon bisulfide, 50 parts of alcohol, and 10 parts of finely powdered potassium hydroxide are boiled gently on a water bath for three hours in a flask provided with a reflux condenser. Excess carbon bisulfide and alcohol are distilled off, and the residue treated with water. The crystals separating out are filtered off, washed first with water, then with dilute hydrochloric acid, and finally with water. To obtain the pure substance, recrystallization from alcohol is necessary. Large colorless tablets are obtained, which melt at 154 deg. C. A very satisfactory, and, in fact, a more desirable, product for use as an accelerator is secured by the substitution of sodium polysulfide Na_2S, for caustic potash in the above reaction. A high degree of purification is unnecessary. At some factories the aniline, carbon bisulfide, and sodium polysulfide are mixed in large kettles in the open air. After a short time the whole mass solidifies. This is broken up, vacuum dried, and finely ground. A fairly satisfactory product is thus secured. The reaction taking place in this preparation may be written as follows:

$$CS_2 + 2C_6H_5NH_2 = C \begin{matrix} \diagup NH.C_6H_5 \\ = S \\ \diagdown NH.C_6H_5 \end{matrix} + H_2S$$

This substance is a very efficient catalyser. It seems to do all of its work at the beginning of the reaction, so that it finds considerable use in quick curing stocks. One-half to 3 per cent is customary.

With Dimethyl Aniline: Carbon bisulfide also forms an addition product with this substance. The reaction here is similar to that of aniline.



With Tetrahydropyrrole: This substance $(CH_2)_4NH$ called by the German chemists "pyrrolidin," is secured

Defendant's Exhibit L (Page 2)
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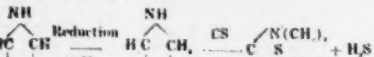
by the reduction of pyrrole, C_4H_5N, by means of zinc dust and hydrochloric acid. Pyrrole is closely related to the proteins, and its derivatives have been isolated from protein decomposition products. The reactions for the preparation of the addition product may be indicated as follows:



With Dimethylamine: As would be suspected, dimethyl amine, $(CH_3)_2NH$, gives an active addition product, whose constitution may be written: $C=S(N(CH_3)_2)_2$

AMMONIUM COMPOUNDS

Ammonium Borate: Dilmar (Gummi Zeitung, Jan., 1915) mentions the fact that ammonium borate has a noticeable effect on the cure. This is merely of scientific interest.

Aldehyde Ammonia: This is a very satisfactory catalyst. A mixture of 100 parts Para, 10 parts sulfur, and 1 part aldehyde ammonia may be cured in 30 minutes at 45 lb. steam pressure (140 deg. C.). For comparison, a batch of 90 parts Para, 9 of sulfur, and 1 of zinc requires 85 minutes at 140 deg. C.

Aldehyde ammonia, $CH_3CH(OH)NH_2$, is best prepared by passing dry ammonia gas into a solution of cold aldehyde, CH_3CHO, in ether. The reaction is as follows:

$$CH_3CHO + NH_3 = CH_3CH(OH)NH_2$$

It is readily soluble in water, sparingly so in alcohol, and almost insoluble in ether. It melts between 70 and 80 deg. C., and sublimes without decomposition at 100 deg. C.

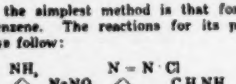
Quaternary Ammonium bases. These are mentioned in Bayer & Co.'s British patent 12,661 of May 22, 1914, along with aldehydic ammonia, para-phenylenediamine, sodium amide, benzylamine, and naphthylenediamine.

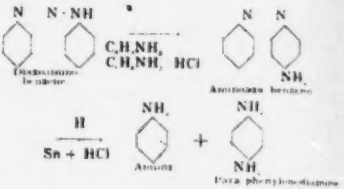
AMINO COMPOUNDS

Para-phenylenediamine: This accelerator gives good results with synthetic rubber. Bayer & Co. mention in their German patent 280,198, Jan. 1, 1914, that 100 parts isoprene rubber completely cures when mixed with 10 parts sulfur and 2 parts para-phenylenediamine and is heated in a press for 15 minutes at 45 lb. steam pressure.

Para-phenylenediamine, $C_6H_4(NH_2)_2$; is produced by reduction of para-nitrobenzene, para-nitraniline, or of aminoazobenzene with tin and hydrochloric acid. Other methods are: By the distillation of diamino benzoic acid. By the action of para-chloraniline on aqueous ammonia in the presence of copper salts.

Perhaps the simplest method is that for reducing aminoazobenzene. The reactions for its preparation from aniline follow:





This method is the most satisfactory, and relatively cheap. Gatterman may be followed for the preparation of aminoazobenzene. After reduction, distill off the aniline with steam. The product may be purified by fractional crystallization. Pure para-phenylenediamine melts at 140 deg. C., sublimes without decomposition at 267 deg. C., is very soluble in alcohol and ether, and moderately so in water. Manganese dioxide and sulfuric acid convert it to quinone, $C_6H_4O_2$. On passing hydrogen sulfide through a solution of the chloride, and then adding ferric chloride, thionine or Lauth's violet is produced. These tests will indicate the purity of the commercial article.

It should be mentioned that para-phenylenediamine, as likewise most organic accelerators, is very poisonous, and proper precautions should be taken in every case.

Tetramethylenediamine: This substance is mentioned in French patent 464,533 by Bayer & Co. It gives very good results when the desired time of cure is rather long.

Tetramethylenediamine, $NH_2(CH_2)_4NH_2$, called sometimes putrescine, is a natural product of protein decomposition, and is produced during the putrefaction of animal matter, such as flesh.

Dimthylene bromide, $Br.CH_2.CH_2.Br$, is converted by treatment with potassium cyanide to dimethylene cyanide, $NC.CH_2.CH_2.CN$. On reducing this substance with sodium and boiling alcohol or by electrolytic methods, tetramethylene diamine is secured.

$$NC.CH_2.CH_2.CN + 8H = NH_2(CH_2)_4NH_2$$

The crystals melt at 270 deg. C. and boil at 157 deg. C.

Miscellaneous Amines: Sodium amide, $NaNH_2$; naphthylenediamine, $C_{10}H_6(NH_2)_2$; trimethylene amine, $(CH_2)_3N$; benzyl amine, $C_6H_5.CH_2.NH_2$; 33 dimethyl 5 tr.methyleneimine; and nitrosodimethyl aninethylline are mentioned as having some accelerating power.

PIPERIDINE AND DERIVATIVES

The first patent granted for an organic accelerator was to Bayer & Co. (German patent 265,221, Nov. 16, 1912) for the use of piperidine. As above mentioned, it was intended to be used with synthetic rubber, but proved so successful that it was tried with the natural variety. A mixture of 100 parts Para, 10 parts of sulfur, ½ part piperidine, is perfectly cured on heating for 15 minutes at 53 lb. steam pressure. Without the accelerator over an hour is required. Piperidine is valuable for both hard and soft rubber articles.

Piperidine, $C_5H_{11}N$, belongs to the class of secondary amines. It is a liquid smelling like pepper and ammonia. It boils at 105.7 deg. C., and has a specific gravity of .881 at 0 deg. C. It is miscible with water in all

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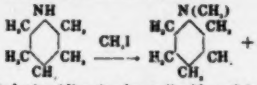
proportions. It is best prepared by reduction from pyridine, either by use of sodium in absolute alcohol or by electrolytic methods (E. Merck, English Pat. 21,471). The reaction is as given on the preceding page.

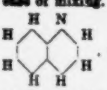
Methyl piperidine: This substance, $C_5H_{10}N(CH_3)$, is also active as a catalyser. It may be prepared by treating piperidine with methyliodide, when the amino hydrogen is replaced by the methyl group.



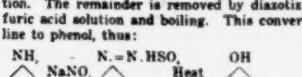
Methyl piperidine is also a liquid, and boils at 107 deg. C.

QUINOLINE AND DERIVATIVES

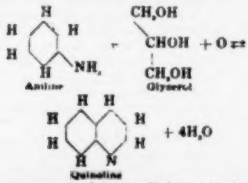
Quinoline and its derivatives are satisfactory accelerators. The amount used varies around 2 or 3 per cent. Perhaps its sulfate and quinosol find the greater application owing to ease of mixing.

Quinoline C_9H_7N,  , may be considered

as a combination of a benzene and pyridine ring. It is most satisfactorily prepared by Skraup's synthesis; to a mixture of 19 parts aniline, 12 parts nitrobenzene and 60 parts glycerol; 50 parts of concentrated sulfuric acid are added. Heat under a reflux condenser until reaction begins. Discontinue. When the energetic reaction is over, heat on the water bath for three hours. Cool, dilute with water, steam distill to remove any unchanged nitrobenzole. Make alkaline, steam distill off the liberated quinoline and any unchanged aniline. Considerable of the aniline can be removed by fractional distillation. The remainder is removed by diazotizing in sulfuric acid solution and boiling. This converts the aniline to phenol, thus:



Quinoline, being a tertiary amine, is not affected. On making alkaline phenol goes into solution, and quinoline is liberated. It can now be removed by steam distillation, after which it is fractionated in order to obtain the pure substance. The reaction for the production of quinoline is sometimes written as follows:



The oxygen required is supplied by nitrobenzole in a manner not quite clear.

Quinoline, sometimes written $C_9H_7\langle{CH:CH \atop N=CH}$ has a sp. gr. of 1.0947 at 20 deg. C. It boils at 240 deg. C., is soluble in alcohol and ether, but only sparingly so in water. It has a disagreeable, penetrating odor, a bitter, acrid taste, and on exposure to moist air is converted to the hydrate, $C_9H_7N + 1\frac{1}{2}H_2O$. The nomenclature of quinoline derivatives is indicated by the scheme

Quinoline sulfate: This is sometimes called quinoline sulfonic acid. For this purpose the 8-acid is most commonly used. It is secured on heating with concentrated sulfuric acid at 220 to 230 deg. C. for a short time. Perhaps the potassium salt of this acid would give better results.

Hydroxy quinoline: This quinoline derivative should be valuable as an accelerator. It may be prepared by the fusion of the 8-quinoline sulfonic acid with caustic potash. It forms prismatic needles melting at 76 deg. C., and boils at 266.6 deg. C. under 752 mm. pressure. It is sparingly soluble in cold water, readily so in alcohol, and volatile with steam. Aqueous solutions of its acid and alkali salts are yellow.

Quinosol: This is 8-hydroxy quinoline, 5-sulfonic acid, and is prepared by sulfonating 8-hydroxy quinoline with cool, fuming sulfuric acid. (Claus and Posset, J. pr. Chem. 1890, 2, 41, 33). Thorpe (Dict. App. Chem. vol IV, 471) prepares it by heating 8-hydroxy quinoline in alcoholic solution with potassium pyrosulfate, $K_2S_2O_7$. Quinosol forms small sulfur yellow needles, melting 175 to 177.50 deg. C. It is soluble in alcohol and in water.

Ditmar mentions oxyquiniline sulfide as a very satisfactory accelerator.

MISCELLANEOUS

Anthraquinone, 3 to 5 per cent is recommended for use in batches containing substitute.

Urea and such derivatives as guanidine are advised.

There are numerous patents covering the various anilides, such as formanilide, etc. Formanilide $C_6H_5.NH.CH:O$, is prepared from aniline and formic acid. On treatment with diphosphorpentasulfide, P_2S_5, thioformanilide is produced, $C_6H_5.NH.CH:S$.

Albumen: An interesting consideration is the patent of W. Esch (German patent 273,482, Nov. 22, 1912), which covers the direct addition of proteins to rubber. He first prepares a paste by mixing the protein, usually egg albumen, 15 parts, with 2 parts hydrated lime or magnesium hydroxide. This paste is mixed with the rubber, dried, sheeted, and smoked, to render the albumen insoluble. Low-grades are considerably improved.

CONCLUSION

To the casual reader this paper must appear rather rambling. I have only been able to touch the high spots in the subject of accelerators. In fact, only the high spots are known. As is customary with most great advances, the untrained investigator tries everything he can possibly think of. The theoretical man follows in his path, and adds his discoveries to the great mass of accumulated facts called "Science." The whole subject of rubber is one demanding scientific treatment. The velocity of the reaction between sulfur and rubber should be investigated more thoroughly and from the standpoint of the physical chemist. In fact, a consideration of this subject along the line of the phase rule would doubtless prove as valuable here as it did in the steel industry.

To the novice in this field patience is most necessary. No substance should be rejected until it has been tried under all possible conditions, and in all possible variations. In this, as in other lines of scientific research, the motto must always be, "Go as far as you can see, and then see how far you can go."

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of the high speed of passage of the reaction gases over the catalyst, a relatively small catalyst chamber will suffice for the oxidation of a comparatively large amount of ammonia per hour, and that secondly, since practically no power is required for the operation, the actual conversion costs, exclusive of that of the materials necessary, will be low. The power required for the production of one ton of nitric acid from ammonia should not exceed 0·015 kilowatt-year, exclusive of the cost of condensation and of concentration, a process which we are carrying out economically without the use of sulphuric acid.

Finally it may be of interest to compare, from a point of view of power, the relative efficiencies of the three most important methods for the fixation of atmospheric nitrogen, namely, the arc process, the cyanamide process, and the direct synthesis of ammonia from its elements.

In making such comparison it will be seen that in the arc process electrical energy alone is involved, while for the direct synthesis of ammonia a mixed requirement of coke (for hydrogen production, steam generation, etc.) and of power (for compression, etc.) is involved. Thus in order to obtain comparative figures it is necessary to translate the coke and other fuel required per ton of fixed nitrogen into units of power. The power equivalent of one ton of coke or coal is the number of units of electrical power which that ton of fuel would be capable of producing if it were utilised for that purpose under efficient conditions. This may be taken at 1500—1600 kilowatt-hours or 0·18 kilowatt-year.

By the arc process one kilowatt-year of power will produce about 600 kilos. of nitric acid or 130 kilos. of fixed nitrogen. For the production of one ton of fixed nitrogen (as cyanamide) by the carbide-cyanamide method, about two kilowatt-years of power plus 3—3½ tons of coal and other fuel are required, making a total power (converting coal into kilowatt-years as above) of 2·6 kilowatt-years per ton of fixed nitrogen. In other words one kilowatt-year by the cyanamide process will fix 380 kilos. of nitrogen as compared with 130 kilos. by the arc process.

Turning to the power required for the direct synthesis of ammonia, 6½—7 tons of fuel (coke and coal)* are required for the generation of the necessary hydrogen and for the production of all power required for the fixation of one ton of nitrogen as ammonia, including the separation of the nitrogen itself from the atmosphere. Converting fuel into power, as before, about 1·2 kilowatt-years are required for the fixation of one ton of nitrogen by direct synthesis of ammonia. Thus one kilowatt-year will fix about 830 kilos. of nitrogen, compared with 380 by the cyanamide method and 130 by the arc process. These figures mean that from the point of view of power and material the direct synthesis of ammonia is more than twice as efficient as the cyanamide process, and more than six times as efficient as the arc process.

These striking results are modified slightly by the difficulty in operating the direct synthesis and by the cost of labour, which is lighter than for cyanamide, together with the necessary dead charges, which are heavier. The direct synthesis of ammonia, however, accompanied where necessary by its subsequent oxidation to nitric acid, presents by far the most economical method of fixing nitrogen at present known, and if only by virtue of the urgent need of the land for cheap, abundant, and non-seaborne fertilisers, deserves every attention from a standpoint of national economy.

Discussion.

Mr. Morley remarked that many statements had appeared recently about the danger of explosion in connection with the Haber process, and he asked if it was possible to make a practical apparatus which would reduce this danger to a minimum. Whilst it was known that the process was practicable on a small scale, with retorts of a capacity of 300 or 400 c.c., he wished to know what was the largest size of retort which could be made commercially.

Mr. Mason asked whether, if it were possible to get cheap power, electrolytic hydrogen would be a possibility.

Mr. Webb asked whether Dr. Maxted adopted the ordinary system of absorption by means of the water towers, or whether an alkali separation or some other system was used.

Dr. Maxted, in reply, said the danger of an explosion as distinguished from a burst could be avoided. The Germans were making ammonia to the extent of a million tons a year by the process. With regard to electrolytic hydrogen, he pointed out that most gases which would generate power would generate hydrogen, and it would be more economical to use them in the latter way. His firm was not using the usual absorption method.

THE CHEMISTRY OF VULCANISATION.

BY D. F. TWISS, D.SC., F.I.C.

Introductory.

Although the hydrocarbon nature of rubber was realised before the discovery of the process of vulcanisation, analysis in approximate agreement with the empirical formula C_5H_8 having been made as early as 1822,[1] the careful examination of purified rubber, both from the point of view of composition and of chemical behaviour, was not taken in hand until years after vulcanisation had become an important technical process. Possibly to some extent because of this delay, but also very largely on account of the difficulties of accurate chemical investigation with a non-crystalline substance which is obtained chemically pure only with exceedingly great difficulty and is affected in a remarkable degree by mechanical treatment, there remain yet many points in connection with the rubber industry of which the scientific interpretations are contradictory, vague, or based on quite insufficient evidence. Nevertheless, more especially during the last ten years, extraordinary advances have been made in the chemistry of rubber.

As was first clearly demonstrated by Gladstone and Hibbert[2] the unsaturation of the caoutchouc molecule is such that two atoms of chlorine or bromine may be added for each C_5H_8 group present, any further introduction of halogen occurring only by displacement of hydrogen. More definite information as to the intra-molecular structure of rubber was supplied by the investigations of Harries. As a result of these and other researches the caoutchouc molecule is to-day regarded as composed of a succession of $-CH_2.C(CH_3):CH.CH_2-$ groups linked together into a ring of uncertain dimensions.[3] This constitution is in good accord with the possibility of the polymerisation[4] of isoprene, $CH_2:C(CH_3).CH:CH_2$, to caoutchouc, the movement of the double bond being commonly observed in a conjugated system of ethylenic linkings $-C:C.C:C-$ on the addition of a univalent atom or group at the first and fourth carbon atoms.[5]

As would be expected of an unsaturated hydrocarbon (C_5H_8)$_n$, containing an ethylenic linking in each C_5H_8 group, caoutchouc forms additive compounds with many of the reagents for olefinic substances, *e.g.*, with the halogens[7], the halogen hydracids[8], "nitrogen trioxide"[9], nitrogen dioxide[10], ozone[11], and chromyl chloride[12].

It is at first sight almost surprising that until recently so few of the reagents for olefinic compounds

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have been even tentatively suggested as agents for vulcanisation. The use of chlorine, bromine, iodine, and aqueous hypochlorous acid was suggested fairly early for this purpose[13], whilst in more recent years, benzoyl peroxide, which might be expected to react additively at a double bond as its parent compound hydrogen peroxide is known to do, and various aromatic nitro- and polynitro-compounds, which are known as a class to form additive compounds with olefinic substances[14], have been stated to convert rubber into a condition resembling vulcanised rubber[15]. The resemblance, however, is so remote that no serious hope can at present be entertained for a successful application of these substances to technical vulcanisation, although the result is certainly of interest, as showing that such reagents can produce a change in the physical characteristics of raw rubber.

The general chemical behaviour of caoutchouc would lead to the expectation that this substance would react fairly readily with sulphur chloride and also with sulphur, the former of which has for many years been known to yield additive compounds e.g., $(C_5H_8)_2S_2Cl_2$, with olefines[17]. As is well known, the technical vulcanisation of rubber is invariably effected by one or other of these substances. Additional ingredients may be and commonly are added to the rubber in order to ensure desired physical characteristics such as colour, definite specific gravity, coarseness, strength, or even (in the case of vulcanisation with sulphur) increased rate of vulcanisation, but the vulcanising effect itself is produced by sulphur or sulphur chloride. At a casual glance it is sometimes possible to overlook the presence of sulphur in some published rubber mixings on account of its introduction in "antimony sulphide" or "black hypo" containing a considerable proportion of free sulphur or as some proprietary "vulcanising compound" such as an intimate mixture of sulphur and wax.

Cold vulcanisation.

Vulcanisation by means of sulphur chloride is effected at or near the ordinary temperature and is restricted to thin rubber material. The material is dipped into a solution of sulphur chloride in some suitable inert solvent or is exposed to the vapour of such a solution. Parkes, who discovered the method in 1846, used a solution in carbon bisulphide.

Various investigators have submitted this process of "cold vulcanisation" or "cold cure" to scrutiny. An obvious difficulty in the way of accurate interpretation is the fact that cold vulcanising as technically practised is largely restricted to the surface layers and is not uniform in effect at various distances below the surface of the rubber. In consequence of this, the research methods employed have in some cases necessarily deviated somewhat from the technical conditions, the most definite results having been obtained from the action of excess of sulphur chloride on purified rubber in solution in benzene[18], when, whatever the excess of sulphur chloride applied, the product approximated to the composition $(C_{10}H_{16})_2S_2Cl_2$, which is analogous to that of the additive compound derived from sulphur chloride and the simple olefines, such as ethylene itself (see above). In view of the complications likely to arise from the presence of organic impurities natural to raw rubber and from the liability of sulphur chloride to vary in composition and to be affected by even slight traces of moisture which may cause the formation of insoluble sulphur (see later), the rather divergent results of earlier investigators[19] are not surprising. There can be no reasonable doubt that the action of sulphur chloride on rubber in cold vulcanisation is definitely chemical and that the final product is a compound of the composition just stated. As to what may happen to the general mass of rubber when in technical practice a piece of rubber almost is allowed to combine with a quantity of sulphur chloride quite insufficient to convert it wholly into the final additive product, is largely a matter of speculation which receives further mention below.

Heat vulcanisation.

The discovery of the great improvement in the mechanical properties of rubber induced by mixing with sulphur and submitting to a temperature between 135° and 140° C. (Goodyear, 1839) or by dipping the rubber articles into molten sulphur (Hancock, 1843) preceded Parkes' discovery of cold vulcanisation, but although the process of "heat vulcanisation" or "heat cure" is more general, its phenomena are even more complex and obscure.

That the chemical process in heat vulcanisation is purely additive was clearly demonstrated by Weber[20] who was also able to show that the limit of vulcanisation is reached when the proportions of rubber and combined sulphur approximate to the formula $C_{10}H_{16}S_2$, an observation which has received definite confirmation from the results of several other investigators[21]. Weber's views as to the formation of definite intermediate compounds, based on the assumptions that 2% forms a minimum proportion of sulphur for a satisfactorily vulcanised soft rubber and that certain discontinuities in his curve showing the percentage of combined sulphur plotted against the period of vulcanisation at constant temperature were of real significance, have, however, proved to be incorrect and due mainly to inaccuracies inherent to his experimental method. The course of the vulcanisation process under constant conditions is quite regular and smooth, the rate of combination of rubber and sulphur decreasing quite gradually as the amount of available free sulphur (and rubber) diminishes[22].

Although the process of heat vulcanisation presents a more complex problem than that of cold vulcanisation, it lends itself much better than the latter to scientific investigation on account of the possibility of so selecting the temperature that the reaction proceeds with conveniently measurable velocity. The velocity of combination of sulphur and rubber is increased by raising the temperature, the temperature coefficient[23] of approximately 2·7 for 10° falling within the usual limits of the value for a chemical reaction.

The phenomena during the heat treatment of a mixture containing rubber and sulphur will obviously include physical changes such as the melting of the sulphur and the dissolution of the molten sulphur in the rubber; by the latter the sulphur will become more uniformly diffused throughout the rubber, whereas previously it was localised in solid particles[24]. Indeed, in the Hancock process it is evident that the diffusion of the molten sulphur into the rubber must form an essential preliminary stage to vulcanisation beneath the surface. The melting and dissolving of the sulphur[25] have been followed under the microscope as also has the inverse crystallisation of the excessive dissolved sulphur[26], the latter, indeed, being well known in the so-called "blooming" or "sulphuring up" of heat vulcanised goods containing a considerable quantity of uncombined sulphur.

The adsorption theory.

With an additive chemical reaction between sulphur and a colloidal substance like rubber accompanied by a reversible solution process, the periodic recurrence of the suggestion that the vulcanisation process is not chemical but merely a physical adsorption phenomenon, is not surprising. In 1910, Wo. Ostwald[27] revived this theory with all the available favourable evidence, and his paper has caused the evidence to be sifted so thoroughly as entirely to dispose of the idea that vulcanisation can be a purely physical change. Ostwald's paper consisted of a review of the work of a few

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earlier investigators with an explanatory commentary biased in favour of the adsorption theory. Most of the arguments, however, suffer under close examination[39] and have received severe criticism, especially by Loewen[40]. Apart from accepting and applying to the purpose of his theory the peculiarities in Weber's experimental results which have since been proved to be due to mere inaccuracies and not to any corresponding abnormalities in the behaviour of the rubber-sulphur mixing[41] Ostwald's claim that vulcanisation is reversible,* based on the earlier statement of Höhn, is not in accord with the present impossibility of reproducing "raw rubber" by the "regeneration" or "reclaiming" of vulcanised rubber (see later), whilst his calculation that the results of Hinrichsen and Stern[42] and of Hübener[43] on the combination of rubber and sulphur are in agreement with the adsorption formula $\frac{x}{a} = kc^{\frac{1}{n}}$ where x represents the quantity of sulphur absorbed, c the original concentration of the sulphur, and a the quantity of the adsorbent, whilst k and n, are constants, is vitiated by the fact that he has misunderstood the figures quoted by Hübener from Hinrichsen and Stern and has used for the calculation figures corresponding in reality with an equation $\frac{x}{a^2} = kc^n$. The correct figures are no confirmatory of the view that the process is one of adsorption[39]. In like manner, the statement that in vulcanisation the sulphur never passes entirely from the free condition has been proved incorrect[44], whilst the remarkable alteration in physical properties observed in the formation of vulcanite and the fact that vulcanised rubber yields a bromo-derivative[45] and a nitrosite[46] containing combined sulphur, are great obstacles in the way of the acceptance of the purely physical conception of vulcanisation. Ostwald's sweeping assertions with respect to the nature of vulcanisation have caused the chemists to establish their faith on a firm experimental basis, and have thereby served to strengthen the position of the chemical theory.

Other theories.

Various modifications of the chemical theory of vulcanisation have been suggested. Erdmann proposed the explanation that sulphur acts on rubber in a triatomic condition, which he describes as thiozone by analogy with ozone; this theory[35], however, lacks experimental confirmation and, in the light of our knowledge of the allotropic forms of sulphur, is improbable.

Although the occurrence of chemical reaction between rubber and sulphur during vulcanisation cannot well be denied, this change may not be exclusively chemical in nature, and endeavours, with much in their favour, have been made to represent vulcanisation as a combination of a chemical change with an adsorption process. The suggestion that the free sulphur is adsorbed before vulcanisation[39], appears unnecessary and is less attractive and less probable than that the chemical product of vulcanisation is adsorbed into the remaining rubber after its formation. Examination of various technical soft products vulcanised by the heat process shows that the amount of sulphur in combination with the rubber is variable[27], but almost without exception falls somewhere between the limits of 2% and 7% calculated on the rubber present. Bearing in mind that the only definite chemical product of heat vulcanisation is of the composition $C_{10}H_{16}S_2$ (see above) containing approximately 47% of sulphur calculated on the rubber, it is obvious that technically vulcanised rubber represents no definite chemical compound but probably a solution or adsorption product of a more highly vulcanised product, possibly $C_{30}H_{48}S_6$, in an excess of very slightly vulcanised or sulphur-free rubber, the physical characteristics of the latter being modified by the presence of the admixed compounds[34]. Ostromisslenski[47], indeed, who regards his experimental results on the effect of aromatic nitro-compounds and of benzoyl peroxide as favouring such a view of vulcanisation, states that the vulcanisation of raw rubber can be effected by the addition of a small percentage of already formed caoutchouc hydrochloride or tetrabromide and subsequent heating, but his conception of a satisfactorily vulcanised rubber is rather wide. According to this view, vulcanisation in the sense of the acquisition of new physical properties by the general mass of the rubber, although not independent of the chemical combination of sulphur with part of the rubber, occurs subsequently to this combination and the small proportion of additive compound produced may be regarded as the direct vulcanising agent acting by "catalysis." The alteration in the main portion of the rubber, consequently, would be accompanied by no change in composition and must be ascribed to some alteration in the molecular condition which may be a polymerisation. Axelrod[39] had earlier propounded a somewhat similar theory involving the assumption that vulcanisation comprises two processes, one of which is the combination of sulphur and rubber. As is well known, heat tends to soften rubber whereas vulcanisation tends to produce the contrary effect. In Axelrod's explanation, the vulcanisation process depends on a primary softening, commonly described as "depolymerisation" or in a less committal manner as "de-aggregation"[48] of the rubber, followed by a "repolymerisation" under the influence of combination with sulphur[42]. Colour is given to this view by the fact that after the whole of the free sulphur has disappeared into chemical combination, further heating produces a weakening and softening effect; this indeed occurs to a greater or less extent in the "reclaiming" or "regeneration" of vulcanised rubber scrap by heating with acid or alkali, in which the material is again rendered sufficiently soft and tacky to be incorporated afresh as a diluent in rubber mixings[49]. Whether the so-called depolymerisation and repolymerisation as postulated in Axelrod's theory actually do occur alternately and repeatedly is not proven and it is possible that the two processes are independent and merely concurrent. The likelihood of modifications in the physical nature and molecular condition of rubber during vulcanisation is heightened by the results of Harries, who has shown not only that ordinary raw rubber behaves as if composed of three mutually interconvertible varieties[23], but also that in ordinary soft vulcanised rubber the major portion of the rubber is not in combination with sulphur although it possesses different physical and chemical characteristics from raw rubber[26]. The very considerable change which occurs when a newly vulcanised rubber is allowed to "mature" indicates that the alteration in mechanical characteristics induced by vulcanisation may continue for a short time after the chemical change is complete[44].

This hypothesis of physical change as induced by the chemical action occurring in vulcanisation has been extended to the process of cold vulcanisation[45] in which the quantity of combined sulphur chloride is likewise quite insufficient to convert the rubber entirely into the final additive compound.

It should, however, be clearly realised that these views in no wise support the adsorption theory of Ostwald, whose claim was that no chemical com-

* For a reply to the alternative argument that an adsorption process need not be reversible, as instanced by the case of methyl violet and charcoal, see Hinrichsen, Kolloid. Chem. Ind. Kraft, 1911, 6, 245.

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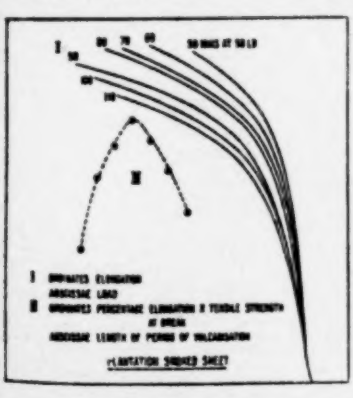
bination whatever occurred between the rubber and the sulphur, but that the latter was merely absorbed by a purely physical process.

Rate of vulcanisation.

The rate of vulcanisation of rubber is of importance for two distinct reasons. It is desirable in works practice that the period necessary for satisfactory vulcanisation should not be too prolonged, but on the other hand, it is very important that the behaviour of various consignments of rubber should be as uniform as possible so as to permit a standardisation of procedure without need for constant re-adjustment.

Examination of the rate of cure may be made from two points of view, viz., by measurement of the resulting physical effect[44] and by determination of the extent to which sulphur enters into combination when a mixing of standard composition is given a definite "cure." With a series of samples of rubber both methods as a general rule give results which fall into the same order, but the physical method possesses an advantage in simultaneously giving an indication of the inherent mechanical value of the rubber. Investigation from both points of view concurrently is certainly most satisfactory.

In the former method a standard mixing, frequently sulphur 10 : rubber 90, is adopted, and this is vulcanised for a series of gradually increasing periods at a constant temperature (*e.g.*, in steam under 50 lb. pressure), after which the mechanical properties of strength and stretch of the samples are measured, and the period of vulcanisation necessary to produce optimum mechanical properties decided from the results (see curves 1 and 2).



The coefficient of vulcanisation, *i.e.*,

$$\frac{\text{combined sulphur} \times 100}{\text{rubber}}$$

corresponding with the optimum period generally has a value of about 5, but it is improbable that such a coefficient would prove the most satisfactory for all purposes[45]. The results, however, are usually intended only for comparative purposes, and it is easy by their aid to detect a rubber of unusual quality either in mechanical strength or in rate of vulcanisation.

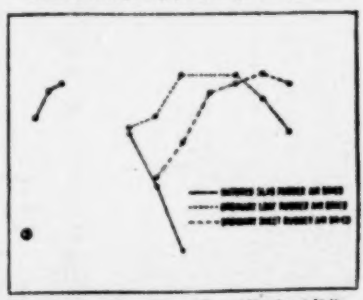
Natural accelerators.

Rubber is not a pure hydrocarbon substance, but is contaminated with natural resins[46] and protein substances[47], and it has been found that these foreign ingredients appreciably affect the rate of vulcanisation. If the resins[48] and more especially the protein matter[51] be removed from the rubber the rate of vulcanisation is decreased in a marked manner, whereas if rubber is enriched in natural proteins by dissolving away part of the rubber hydrocarbon with benzene, the rate of vulcanisation of the protein-enriched rubber is enhanced. Possibly as an outcome of this discovery, the addition of a mixture of lime and albumin[51] has been patented as a method for accelerating vulcanisation, but lime itself catalyses the vulcanisation process, and the increase in the rate of "cure" may not be due entirely to the albumin.

In the earlier days of the plantation rubber industry, considerable stress was laid on the variability in the rate of vulcanisation of "plantation Para" rubber as compared with the wild Para rubber. More recently, Eaton and Grantham, working in Malaya, have been able to discover the chief cause of this variability, and, indeed, to indicate the possibility of a step of great value in the production of raw rubber. In the ordinary plantation procedure, the rubber coagulum, obtained from the latex, is washed and crêped with the intention of removing the serum as completely as possible; if, however, the soft slabs of coagulum are allowed to "mature" for several days before the retained serum is expressed, it is found that the resulting rubber vulcanises with unusual rapidity, the effect attaining its limit after a period of roughly seven days before washing and crêping[52]. The rubber from such matured slabs when mixed with 10% of sulphur attains its optimum condition of vulcanisation in approximately one-third of the ordinary period.

Curves 3 and 4 show the behaviour of rubber prepared in this way as compared with the ordinary qualities of plantation rubber from the same estate; with the period of vulcanisation which gives the optimum results for the ordinary qualities, the special rubber is excessively over-vulcanised.

Tensile strength by percentage elongation.



The cause of this difference has been traced by Stevens[53], who has shown that during the maturing process, the protein matter of the retained serum undergoes decomposition with formation of organic bases which remain absorbed even after washing. Such bases are well known to possess considerable catalytic activity towards the heat vulcanisation of rubber (see later).

Although the difference in rate of vulcanisation as compared with rubber produced in the ordinary manner is less marked in technical mixings, the great advantage of a uniform supply of such rapidly vulcanising rubber for special purposes

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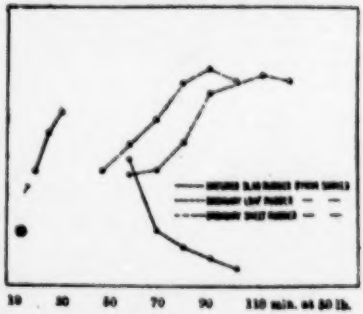
will readily be recognised, and experiments as to the possibility of producing large quantities of rubber with a uniform high rate of vulcanisation will prove of great interest.

Inorganic accelerators.

Goodyear himself realised that the process of vulcanisation could be hastened by the inclusion of calcined magnesia in the rubber-sulphur mixing, and the use of this substance, as also of litharge and calcium hydroxide (and, to a less extent, of magnesium carbonate), has for many years been a recognised device of the manufacturer to shorten the period necessary for the vulcanisation of his mixings. Various suggestions have been made to explain the effect of these substances, but few bear critical examination; thus conversion into sulphide followed by alternate formation and

Tensile strength by percentage at break.



decomposition of polysulphides, by which process the sulphide acts as a "sulphur carrier"[45], is improbable, because the corresponding sulphides are less efficient than the oxides or hydroxides, whilst it is also unlikely that magnesium oxide is largely converted into sulphide during vulcanisation; even the accelerating effect attributed to antimony sulphide[46] is largely due to misconception arising out of the effect of the free sulphur commonly present in this material.

Litharge has been a favourite subject for speculation. Its effect has been attributed, at different times, to its aiding the conduction of heat into the rubber mass[47], and to the heat evolved by its oxidising action on the rubber resins or on the hydrogen sulphide arising from the interaction of the resins and sulphur[47]. The rise of temperature due to such liberation of heat would cause a corresponding increase in the rate of reaction between sulphur and rubber, and it is probable that a thermal effect of this kind is produced by the direct or indirect action of the lead oxide on the sulphur[48]; the occurrence of a thermal effect in litharge mixings can indeed be detected by direct measurement of the temperature of the mass during vulcanisation.

A highly fanciful explanation of the effect of litharge and other oxide accelerators has been proposed lately[49]. The heating necessary for vulcanisation is assumed to cause the sulphur to attack the natural resinous matter and proteins and the litharge simultaneously, with formation of hydrogen sulphide and sulphur dioxide respectively. These two gases then react in the recognised manner, and the acceleration of the vulcanisation process is attributed to the exceptional activity of the amorphous sulphur thus produced. Apart from the improbability that two gaseous substances are formed in definite molecular proportions by independent chemical reactions as an essential part of the vulcanisation process, the facts that sulphurous acid and acid sulphites retard vulcanisation[50], and that colloidal sulphur does not give accelerated vulcanisation (see below) are diametrically opposed to this theory.

Apart from the above basic accelerators, the only inorganic accelerators which have been proposed are various metallic iodides, antimony iodide in particular[51]; in this case it is possible that the effect may have been due to the conjoint action of sulphur and iodine on the rubber; this method of acceleration appears never to have come into general practice.

Organic accelerators.

In recent years a notable advance in the technique of heat vulcanisation has been the introduction of organic bases as accelerators. The first published statement as to the use of an accelerator of this type appears to have been in the patent specification protecting the application of the strongly alkaline base piperidine, $C_5H_{11}N$ [52]; a claim by Spence to priority[53] in the use of this and other organic accelerators is still awaiting promised details. After piperidine, the use of many organic amines was patented[54], a final claim covering the application of all organic bases of dissociation constant exceeding 1×10^{-6}. It is inconvenient to apply some of these bases in the free condition on account of their volatility, which may cause loss by evaporation, or also may tend to produce porosity in the vulcanised rubber; this disadvantage may be obviated by previous conversion of the base into the corresponding carbamide[55], dithiocarbamate, carbamate, or carbonate derivative. Indeed, I have also found that the unstable base aminoguanidine forms an excellent accelerator when applied in the form of its more stable bicarbonate salt[56], while ammonium bicarbonate is also very effective.

One of the most powerful of these organic catalysts is aldehyde-ammonia, the effectiveness of which far outweighs what might be expected of its ammonia content, and must be regarded as a specific property of aldehyde-ammonia itself. Indeed, from the purely chemical point of view also, the behaviour of aldehyde-ammonia is somewhat abnormal, and although it must be regarded as a definite organic base its constitution is not settled beyond doubt[57].

It is a remarkable circumstance that almost the whole of the known effective* organic accelerators are basic, a rough proportionality apparently existing between their activity and their alkalinity, relatively feeble bases like aniline and methylaniline having little influence on the rate of vulcanisation. The mineral accelerators mentioned earlier are also alkaline or basic substances, and it appears highly probable that this is no mere coincidence but that the two classes of substances in common owe their influence in some way to their basic character. If this is really so, the alkali hydroxides should also be strong accelerators and experimental examination proves the correctness of this argument. For a long time it has been known that regenerated rubbers obtained by heating with alkali sometimes vulcanise with exceptional rapidity[58]; Martin[59] also has demonstrated that the introduction of a small percentage of powdered caustic potash into a mixture of rubber and sulphur causes a greatly increased rate of vulcanisation, whilst Eaton more recently has shown that a similar effect is produced with rubber which when freshly coagulated has been soaked in

* It is difficult to understand on what grounds certain substances have been described as accelerators; *e.g.*, see a list of accelerators by King, (Intelligence and Chemical Engineering, 1916, **18**, 231.

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caustic alkali solution. The latter investigation, however, has since withdrawn his recommendation of this process [70].

Several years ago, influenced by the fact that the inorganic and organic accelerators were all basic substances, I became of the opinion that both classes of substances exert their influence in a similar manner and that the relative advantage attaching to the use of organic bases depends chiefly, if not entirely, on the fact that these are soluble in rubber and therefore become more uniformly distributed and diffused, whereas the inorganic accelerators, being only sparingly soluble, remain for the most part localised in small solid particles, which, indeed, are frequently visible to the naked eye. For this reason I sought a suitable organic liquid which would dissolve in rubber and also would act as a solvent for an alkali hydroxide, because a solution of this kind would possess marked alkalinity and also would be capable of blending uniformly with rubber, thus reproducing the conditions which obtain when an organic accelerator is used, without any accompanying danger of porosity. The most suitable solvent discovered was glycerol which dissolves sodium hydroxide or potassium hydroxide, probably with formation of the corresponding glyceroxide [71]. The latter alkali is more easily soluble and a solution containing approximately 25% on the total weight is easily obtained. If 1–2% of such a solution (anhydrous) is introduced into a rubber-sulphur mixing, the vulcanisation process is greatly accelerated, the effect being comparable with that of the strongest organic accelerators, as is demonstrated by the figures below. It is also noteworthy that the actual quantity of alkali used approximates closely to the 0·5% recommended for the most effective organic accelerators and that with a rubber-sulphur mixing the resulting vulcanised rubber, in both cases, possesses the same clear, dark, almost semi-transparent appearance.

In earlier experiments, I had endeavoured to effect the uniform distribution of the alkali into the rubber-sulphur mixing by introducing it in the form of a finely-powdered mixture of the alkali with lime, but although the results were certainly gratifying, they were less consistent than those obtained with the glycerol solution.

The following figures give the residual uncombined sulphur after a mixing of 95 rubber : 5 sulphur with the addition of the stated accelerator was vulcanised for 90 minutes at 40 lb. steam pressure :—

Accelerator.	% of Accelerator.	Residual free sulphur %.
(1)	—	3·60
(2) Potassium hydroxide in glycerol	2 (of solution 1 : 4 approx.)	0·31
(3) Sodium hydroxide in glycerol	2 (of solution 1 : 8 approx.)	0·41
(4) Acetoguanidine	1	0·60
(5) Ammonium carbonate ..	1	1·39
(6) Aldehyde-ammonia	1	0·17
(7) p-Nitrosodimethylaniline	1	1·06

As will be observed from the above results, p-nitrosodimethylaniline [72] does not accelerate very strongly under the conditions chosen. This is due, at least in part, to the fact that the mixing selected contains a relatively low proportion of sulphur. The nitroso-compound is much more effective in mixings containing a high percentage of sulphur and it is probably because mixings containing litharge or antimony sulphide are usually intended to have a good colour and, therefore, in order to prevent excessive "blooming," are generally prepared with a low percentage of free sulphur, that these have been found to behave less satisfactorily with the nitroso-compound [73].

Mode of action of accelerators.

As the effect of accelerators in general is most distinct in mixings otherwise containing only rubber and sulphur, their action presumably must be by influence on one of the ingredients present, viz., (1) the natural protein and resinous matter, (2) the sulphur, or (3) the rubber hydrocarbon.

The first possibility is eliminated by the fact that the accelerators work equally well with rubber from which the protein matter has been removed, one of their first uses indeed being to render protein-free synthetic rubber capable of more rapid vulcanisation.

With respect to the possibility of acceleration as due to the influence of the catalyst on the sulphur, the suggestion has been made [74] that with organic, as with inorganic accelerators, polysulphides are first formed which then effect the vulcanisation of the rubber. As has been explained already, this theory is not altogether satisfactory for the effect of the basic oxides generally.

A possibility which appears to have been previously overlooked, but which at first appeals to the imagination, involves the two allotropic forms of liquid sulphur. Molten sulphur consists of a mixture of mobile yellow S_λ with viscous deep brown S_μ, the exceptional behaviour of molten sulphur with alteration of temperature being due to variation of the relative proportions of these constituents [75]. When molten sulphur is cooled, the S_λ variety gives rise to ordinary soluble crystalline sulphur, whilst S_μ produces insoluble amorphous sulphur. In molten sulphur an equilibrium is slowly attained between these two forms, but the existence of S_μ is favoured by the presence of acids, whilst alkalis such as ammonia or doubtless organic bases, facilitate the conversion of S_μ into S_λ.

The remarkable parallel between this effect of acids and bases on the $S_\lambda \rightleftarrows S_\mu$ equilibrium and that of acids and bases in respectively retarding and accelerating the vulcanisation process, naturally arouses a suspicion as to the existence of some connection between the two sets of phenomena. In order to test this possibility, insoluble amorphous sulphur corresponding with S_μ was separated from genuine flowers of sulphur by extraction of the soluble S_λ with carbon bisulphide. Comparative vulcanisation tests were then made with rubber-sulphur mixings employing this insoluble sulphur and ordinary totally soluble sulphur. Although my results actually indicated that S_μ combined with rubber rather more slowly that S_λ the difference was relatively slight and quite insufficient to account for the great effect of the organic basic accelerators.

Mixing.	Period of cure at 40 lb.	Residual free sulphur.
Rubber 100 : soluble sulphur 10	120 minutes	0·39
Rubber 100 : insoluble sulphur 10	120 "	0·61*

* This residual sulphur, after vulcanisation, is found to consist mainly of the more soluble modification.

Although this result disposes of the probability of any real connection underlying the parallel between the action of acids and alkalis in the $S_\lambda \rightleftarrows S_\mu$ equilibrium and in the process of vulcanisation, it is of additional interest as also disposing of Dubosc's suggestion that the action of inorganic catalysts in vulcanisation depends on the production of amorphous sulphur for which he postulates exceptionally great vulcanising activity [76].

The immediately preceding considerations to some extent narrow down the enquiry as to the mode of action of the basic accelerators. Either

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the sulphur is influenced in some other way than those mentioned, or the effect must be produced on the rubber itself. On account of the colloidal nature of rubber and its obscure "depolymerisation" and "polymerisation," the investigation of the latter alternative is more difficult. Nevertheless, the knowledge that alkalis increase the stability of the independent rubber globules[19] in ordinary rubber latex and the observation that even coagulated and worked rubber retains traces of a globuloid condition[20], might be regarded as suggestive of a possibility that alkalis are likely to affect the behaviour of finished raw rubber, *e.g.*, by influencing the inter-conversion of modifications in different states of molecular aggregation and of different reactivity. Such a possibility indeed, would be in accordance with C. O. Weber's observation[20] that when rubber is masticated with litharge only, in the absence of sulphur, the material undergoes a remarkable change in physical properties.

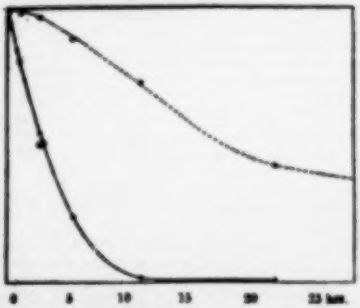
There is much more room for further investigation on the question of the chemical mechanism of the acceleration of vulcanisation.

Other considerations.

The existence of the above-mentioned soluble and insoluble modifications of sulphur is well worth bearing in mind in other directions. For instance, although it is generally accepted that the free sulphur in an ordinary rubber mixing can, for all practical purposes, be removed completely by continuous extraction for ten hours with acetone, the remaining sulphur being regarded as in combination with the rubber, the above unvulcanised mixing containing "insoluble" sulphur yielded only 27% of its sulphur in this period.

Comparative extractions were made with the two mixings containing respectively soluble and insoluble sulphur, by treating samples with acetone in a continuous extractor at the temperature of the boiling solvent; the rate of extraction is represented in the following curves.

Residual sulphur.



Any conclusions as to the reversibility of vulcanisation based on the possibility of removing sulphur from vulcanised rubber by prolonged extraction[20] even after as much as twenty hours' previous extraction, are, therefore, unjustified[20] unless definite proof is supplied as to the absence of "insoluble sulphur." It has also been stated by Bysow that in cold vulcanisation, sulphur and chlorine do not combine with the rubber in equivalent quantities[21], but traces of moisture in the rubber would cause the decomposition of part of the sulphur chloride with formation of some insoluble sulphur and would account for the apparently disproportionate quantity of "combined" sulphur.

The evidence for the supposed vulcanisation of a rubber-sulphur solution at the ordinary temperature by ultraviolet light[22] is also unconvincing. From the observation that a rubber-sulphur solution in benzene, when exposed in a thin film to ultraviolet radiation, becomes more viscous and that after evaporation of the solvent, part of the sulphur is not removed by an ordinary four-hour extraction with acetone, the conclusion has been drawn that the unextracted sulphur has combined with the rubber. However, ultraviolet light is already known to convert dissolved sulphur into insoluble sulphur[23] (or Rh into Ro) and although the Rp may not separate as visible particles it is quite likely to remain in ultra-microscopic colloidal suspension.* Ultraviolet light also, without the aid of sulphur can render rubber solution more viscous and improve the strength of thin rubber sheet[24].

The above alterations in the rubber-sulphur solution appear to be quite insufficient evidence of vulcanisation, and the observed changes, at least in part, may consist of independent physical changes in the rubber and sulphur respectively; indeed this possibility appears to receive some confirmation from Bernstein's doubts as to whether the sulphur in vulcanisation becomes chemically combined or merely physically adsorbed[25].

The preceding review of the chemistry of vulcanisation shows how great has been the activity in this direction, especially during recent years, but will also indicate how wide are the gaps of knowledge which at present are bridged over by mere theories and need to be filled up with a solid mass of experimental evidence.

Many of the results referred to in this paper as obtained by other investigators have been re-examined and confirmed.

For permission to publish the new results included, I am indebted to Dr. J. V. Worthington, Technical Superintendent and Director of the Dunlop Rubber Company, whilst for curves 1 to 4 and for many tests made in connection with points brought under consideration, I wish to express my indebtedness to Mr. A. W. T. Hyde, Head of the Physical Testing Laboratory of the same firm.

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DISCUSSION.

Dr. H. P. STEVENS said that he had carried out some experiments with benzoyl peroxide, but had obtained no results up to date which were really comparable with the results obtained with sulphur. On the other hand, he did not think his own research, at any rate, went sufficiently far to enable him to make the statement that benzoyl peroxide could not be used technically, and if Dr. Twiss had made experiments of his own, it would be interesting to hear what the results had been. A point often lost sight of was the effect of temperature on physical tests. In a paper read at the last rubber conference in London, an American investigator, Wormeley, had shown that variation of temperature produced a very large effect on the results of physical tests. He had found, for instance, that a difference in temperature of 20° F. a difference frequently met with in the test room between summer and winter—produced something like 10% difference in the tensile strength and elongation of the product. Up to now there appeared to be no appliance by which the temperature of the specimen during the test could be controlled. It was also important that previous to testing the specimen should be kept at a constant temperature. With regard to the rapidly vulcanising rubber produced by allowing the rubber to mature, he took it that such a rubber would be of greater value than the ordinary trade rubber as now supplied. During maturing oxidation took place, weakening the surface. It was interesting to hear of the author's experiments with the use of potash and soda. So far as he understood it, the results obtained with such an accelerator were in all respects comparable with those obtained with organic accelerators. There had been an idea that traces of alkali affected the stability, that was to say, the ageing qualities of rubber.

Dr. TWISS, in reply, said he had, as Dr. Stevens suggested, made experiments as to the possibility of vulcanising rubber with benzoyl peroxide and nitro compounds. The products did not compare in strength with technically vulcanised rubber. It seemed to him, however, that it was only a matter of time for substances to be found which would have an effect similar to that of sulphur chloride. As to the samples vulcanised in the presence of the alkali solution in glycerol, in the period that had elapsed since these mixings were vulcanised, now almost three years, a certain weakening was observed, but no greater than in similar mixings containing other accelerators used with considerable success by some manufacturers.

THE SCIENTIFIC NEEDS OF THE RUBBER INDUSTRY.

BY R. D. PORRITT, M.SC. (LOND.), F.I.C.

If statistics were available to show the numbers of men with scientific training absorbed annually by various British industries during the last twenty years, that of rubber certainly would be found to occupy a very humble position on the list, far below what might be expected in view of its commercial importance, and intricate character. Moreover, it would be apparent that until the last decade a chemist was practically unknown in the majority of factories engaged in this trade. Even at the present time a technical laboratory set aside solely for the purpose of research is a rarity, and the duties of the average rubber chemist still remain essentially what they

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REACTIONS OF ACCELERATORS DURING VULCANIZATION[1]

II—A THEORY OF ACCELERATORS BASED ON THE FORMATION OF POLYSULPHIDES DURING VULCANIZATION

By Winfield Scott and C. W. Bedford[2]

THE INVESTIGATION of organic accelerators, as shown by the literature of the past five or six years, appears to be confined largely to a search for new compounds, or a combination of compounds to catalyze the addition of sulphur to rubber. It has been shown that these accelerators are almost entirely organic nitrogen compounds, and as a result nearly all classes of nitrogen-containing substances have been tried. Furthermore, it has been shown that the nitrogen of such compounds is basic or becomes basic during vulcanization by the action of heat, sulphur, or hydrogen sulphide.

It has been previously proposed that a sulphur reaction of the accelerator is necessary, and certain reaction products in some way make sulphur available for vulcanization. In some cases a sulphur reaction is doubtless necessary to form the true accelerator, which is a polysulphide.

The latest theory for the action of accelerators during vulcanization is that of Kratz, Flower and Coolidge[3]. These writers attribute the accelerating action of amines, such as aniline, to the formation of an unstable addition product of aniline and sulphur, in which the sulphur is temporarily attached to the nitrogen, making it pentavalent.

The compound thus formed gives up its sulphur to the rubber and is then regenerated by a further reaction with sulphur.

The writer believes that the mechanism of the action of amines is represented differently from that given by the above investigators, and that hydrogen sulphide is one of the important factors in acceleration. It is believed that, in general, amines catalyze the addition of sulphur to rubber. As a specific example, dimethylamine, with hydrogen sulphide and sulphur, forms a derivative of ammonium polysulphide as follows:

$$(CH_3)_2NH + H_2S \longrightarrow (CH_3)_2NH_2SH$$

$$(CH_3)_2NH_2SH + xS \longrightarrow (CH_3)_2NH_2SH$$
$$\Big|\!\Big|$$
$$S_x$$

Polysulphide compounds similar to the above are considered to be the true accelerators that furnish the sulphur necessary for vulcanization. That this type of sulphur is available for vulcanization has been shown by Ignaz Block[4], who states that hydrogen polysulphides (H_2S_3 and H_2S_4) will cure rubber at ordinary temperatures. C. O. Weber[5] quotes Gerard and his work showing that alkali polysulphides in concentrated solution will also vulcanize rubber.

ORGANIC ACCELERATORS

All organic accelerators do not function in the same manner as the bases, and for this reason the writers choose to divide accelerators into two classes.

I. HYDROGEN SULPHIDE POLYSULPHIDE ACCELERATORS. In this class belong those bases which form polysulphides similar to yellow ammonium sulphide.

II. CARBO-SULPHYDRYL POLYSULPHIDE ACCELERATORS. This includes all accelerators that contain the grouping = C-SH, such as the thioureas, dithiocarbamates, thiurams, mercaptans or the disulphides which may be formed from them by oxidation or by reaction with sulphur.[6]

To the first class belong all basic organic accelerators or ... compounds as produce basic accelerators under curing conditions. Certain inorganic accelerators may also be included. These will be discussed later in the paper.

The second class includes certain of the Schiff bases[7] which form thiourea derivatives by a sulphur reaction during the cure. Further discussion of this class will be reserved for a later paper.

The phenylated guanidines belong to both classes, since at curing temperatures they easily react with hydrogen sulphide to form thioureas and free amines. Diphenylguanidine, for example, gives thiocarbanilide and ammonia.

The present paper deals with the first-mentioned class of accelerators, i. e., with those which, in the presence of hydrogen sulphide under curing conditions, form polysulphides analogous to those of sodium and ammonium.

The structural relationships of the polysulphides of the nitrogen bases and the more positive metals are not clearly understood at present, although it is known that some of the sulphur is held in a more or less loose form of chemical combination. This is evidenced by the precipitation of sulphur from concentrated solutions on dilution, and the generation of heat when soluble ... dissolves in sulphide or hydrosulphide solutions. It is certain that the sulphur of polysulphides is quite different from rhombic or α-sulphur, and that the aggregate S_8 is changed to the sulphur of polysulphides by the combined action of hydrogen sulphide and basic accelerators.

It is a well-known fact that sulphur will react with rubber resins and proteins at temperatures near 140 degrees with the formation of hydrogen sulphide. This hydrogen sulphide in the presence of basic accelerators forms hydrosulphides, which in turn take up sulphur to form polysulphides. These polysulphides pass on part of their sulphur to the rubber and constitute the true curing agents. Such a mechanism applies also to the cure by the action of alkali and alkaline-earth hydroxides. The fact that basic magnesium carbonate will react with hydrogen sulphide and sulphur in water suspension to form polysulphide solutions ... doubt accounts for its mild accelerating power. Lime and magnesia do not function well in deresinated rubbers where ... of the hydrogen sulphide producing materials have been removed. The sulphides and polysulphides of the alkali and alkaline-earth metals should function in deresinated or synthetic rubbers.

The relative accelerating power of the organic bases is dependent upon the facility with which they form polysulphides and the extent to which they are able to activate sulphur to make it available for the rubber. This will, in some measure be dependent upon the basicity. In a previous paper by the writers[8] it was stated that at least a part of the accelerating action of hexamethylene tetramine is due to the fact that during the cure there are produced, among other products, ammonia and carbon disulphide which, alone or with basic products present in the rubber, form dithiocarbamates. It may be added that "Ilex" also forms hydrogen sulphide by sulphur reaction, which with ammonia undoubtedly forms ammonium polysulphides. The accelerator may, therefore, be classed under both types since it both a hydrogen sulphide and a carbo-sulphydryl polysulphide accelerator.

Aldehyde ammonia, by the action of heat alone, forms ammonia while with sulphur it also gives hydrogen sulphide. Heat produces other bases such as the alkyl pyridines or collidine. This material appears to be solely a hydrogen sulphide poly...

[1]Presented before the Rubber Division of the meeting of the American Chemical Society, Chicago, Illinois, September 9-10, 1929. Part I, The India Rubber World, January 1, 1930, pages 294-297.

[2]The Goodyear Tire & Rubber Co., Akron, Ohio, and Quaker City Rubber Co., Philadelphia, Pennsylvania.

[3]Journal of Industrial and Engineering Chemistry, 12, 1928, 21.

[4]German patent No. 219 925.

[5]"Chemistry of India Rubber," page 47.

[6]Although the term polysulphide is applied to each class of accelerators, it should be noted that they are distinct types. In Class I, the polysulphide sulphur is related to a sulphydryl group attached to nitrogen, while in Class II the polysulphide sulphur is held by a sulphydryl group attached to carbon. In the so-called disulphides and their higher sulphides, the hydrogen of the sulphydryl group is considered as having been eliminated in hydrogen sulphide.

[7]Bedford and Scott, Journal of Industrial and Engineering Chemistry, 1929, 21.

[8]The reaction of carbon disulphide on amines to form thioureas or hydrogen sulphide is reversible, and it is entirely possible that by the action of hydrogen sulphide during vulcanization the thioureas are changed to more powerful dithiocarbamates which are intermediate to the cure by transformation to amine and carbon disulphide. It is also possible that thioureas may form polythio compounds direct, through the carbo-sulphydryl group.

[9]Journal of Industrial and Engineering Chemistry, 12, 1920, 21.

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ide accelerator. The ammonia condensation products of other ...dic aldehydes behave in a similar manner.

...-Phenylenediamine is an accelerator that is much more active ... would be assumed from its basicity. At curing tempera..., this accelerator reacts with sulphur to form large amounts ... ammonia and hydrogen sulphide together with certain weaker ...s. If the reaction be carried out under a cold reflux, the ...denser will frequently become clogged with the white solid ...pounds of ammonia and hydrogen sulphide which are described ... Rossze and Schorlemmer. The action of *p*-phenylenediamine ...de cure is entirely that of a hydrogen sulphide polysulphide ...elerator.

The three above-mentioned accelerators are not dependent on ... rubber resins or proteins for their supply of hydrogen sulphide, ...e this is one of their sulphur reaction products. It is to be ...ected that these accelerators will function in a deresinated or ...ynthetic rubber, and the Bayer patents state that this is true. ... also known that piperidine will cure in a nitrogen-free rubber. ...re we have a strong base acting apparently without the aid of ...drogen sulphide. Piperidine, however, reacts with sulphur at ...peratures lower than those used in vulcanization, with the ...mation of hydrogen sulphide. Both the sulphur reaction ...duct and the unchanged piperdine may then use this hydrogen ...phide to form polysulphides with sulphur.

INORGANIC ACCELERATORS

Inorganic accelerators that function in the cure by the removal ... hydrogen sulphide the writers choose to term "secondary accel...ors," while those that function in the same manner as the ...anic polysulphide accelerators may be classed with them as ...imary accelerators." A third class consists of those com...nds that are both primary and secondary accelerators.

I. Secondary Accelerators. Litharge, zinc, oxide, etc., seem ... act no further than to form the corresponding sulphides, in ...nction with hydrogen sulphide polysulphides.

II. Primary Accelerator. To this class belong the ...phides and hydrosulphides of the alkali and alkaline-earth ...tals.

III. Accelerators That Are Both Primary and Secondary. ...rganic oxides and hydroxides function first as secondary ac...erators forming sulphides or hydrosulphides which then take up ...phur and act as primary accelerators. Such accelerators are ...dium and calcium hydroxides, magnesium oxide and basic car...nate, etc.

Secondary accelerators are believed to function as aids to ...anic polysulphides by breaking them up into colloidal sulphur ... the original nitrogen base. This may be illustrated by the ...eterioration of polysulphide solutions by litharge or zinc oxide. ...nc oxide does not act as a secondary accelerator, and neither ...es it readily decompose the polysulphide solutions. The solu...ity of organic accelerators in sulphur and rubber gives them ...ch more intimate contact with hydrogen sulphide at the time ... its formation than is the case with the comparatively large ...rticles of litharge or zinc oxide. Hydrogen sulphide is there...re available for the formation of organic polysulphides before ...ng taken up by the secondary accelerators. The decomposition ... a polysulphide by a secondary accelerator regenerates the free ...e, which with more hydrogen sulphide and sulphur re-forms ... polysulphide. Secondary accelerators do not act as true ...lphurs; once formed into sulphides they do not react again with ...drogen sulphide.

SUMMARY

1. All organic accelerators are believed to function through ... formation of some type of polysulphide.

2. Organic bases and compounds that form bases during vul...nization are believed to form polysulphides through the aid of ...drogen sulphide. These are termed "hydrogen sulphide poly...phide accelerators."

3. Thiourea, dithiocarbamates, thiurams, and mercaptan com...nds are believed to form polysulphides directly, or by first forming disulphides, and are termed "carbo-sulphydryl polysulphide accelerators."

4. It is proposed that the function of such compounds as litharge and zinc oxide may lie in the decomposition of polysulphides into colloidal sulphur and amines.

5. Such inorganic compounds as sodium hydroxide, calcium hydroxide and magnesium oxide are believed to function as "primary accelerators" through the formation of inorganic polysulphides.

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DEFENDANT'S EXHIBIT S

Caoutchouc et Gutta-percha 1919, July 15, p. 9861/9864

Investigation of Vitalyzer - Accelerators

From our earlier investigations it follows that nitrogen-containing organic substances, e.g. amines or imines, capable of giving rise, in the presence of sulfur and carbon disulfide, to sulfocyanic acid and hydrogen sulfide, are apt to act as vitalyzer-accelerators in the vulcanization of rubber.

The representative type of these vitalyzer-accelerators is hexamethylenetetramine.

Other compounds are capable of acting in the same manner; those which we have investigated, such as guanidine, tetraminocarbenzylidineaniline, hydrobenzamide, naphthylenediamine, paranitrosodiphenylamine, the various nitrogen compounds, and particularly, cobaltamines, which are capable of holding as much as 10 to 12 molecules of NH_3, decompose at low temperature and are therefore capable of yielding absolutely new powerful vitalyzer-accelerators.

These compounds will be examined now in succession:

Guanidine: This compound belongs to the urea group and its formula is $\begin{matrix} NH_2 \\ NH_2 \end{matrix} \rangle C = NH$

containing three nitrogenous radicles for one carbonation.

In order to provoke its action in the vulcanization process it is necessary in view of its low carbon content to use it in conjunction with carbon bisulfide.

A reaction sets in accordance with the following equation:

$$(NH_2)_2\ C(NH) + 2(CS_2) = 3(SCNH) + H_2S$$

Guanidine — carbon bisulfide — sulfocyanic acid — hydrogen sulfide

The preparation of guanidine is readily effected.

It is obtained by the action of ammonium chloride NH_4Cl on calcium cyanamide.

The reaction is carried out in an alcoholic menstruum at 100°C. when there is formation of calcium chloride, ammonia, and

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guanidine, according to the equation:

$$CN_2Ca + 2(NH_4Cl) = (NH_2)_2C = NH + CaCl_2 + NH_3$$

Calcium cyanamide is a low-priced product which is derived from calcium carbide and used as fertilizer. It is manufactured on a large scale at Niagra Falls and in the Savoie.

By refrigeration guanidine is readily induced to crystallize from the alcoholic mother-liquor.

It forms hygroscopic white crystals.

It may also be prepared by heating at 180° C. ammonium sulfocyanide in an autoclave. Thiourea is formed simultaneously which is split into hydrogen sulfide and sulfocyanic acids.

The reaction takes place according to the following reaction:

$$2(CNSNH_4) = (H_2N)_2C = NH + CNSH + H_2S$$

Guanidine readily absorbs carbon dioxide from the air with formation of a carbonate which decomposes at 110° C. It is advisable therefore to keep it in sealed receptacles.

Instead of preparing the guanidine separately it is possible to mix its constitutive elements with rubber, e.g. either calcium cyanamide and ammonium chloride, or ammonium sulfocyanide, whereupon, after an intimate mixture has been obtained, carbon disulfide is added in the kneading mill. The resulting mixture is then vulcanized under the same conditions as with hexamethylenetetramine.

In this case better results are obtained with ammonium sulfocyanide than with calcium cyanamide and ammonium chloride, as in the ensuing reaction which then takes soluble place in two phases, all the products act as accelerating vitalyzers, whereas in the other case an inert substance, viz. calcium chloride is obtained as by-product.

The reaction is as follows:

$$2(CNSNH_4) + 2CS_2 = 4(CNSH) + H_2S$$

The results are in the main the same as those obtained from hexamethylenetetramine.

Ammonium sulfocyanide is readily obtained either by the Gelis or by the Norton method by causing carbon bisulfide to act in auto-

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clave on carbamide or, better still, on ammonium carbonate.

Ammonium sulfocyanide may also be readily recovered from the ammoniacal liquor of coke-over plants or gas-works. It is separated from the other ammonia compounds by treating it with copper s which precipitates copper sulfocyanide which is separated by filt

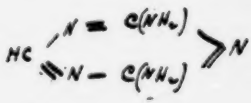
This copper salt is converted into the soluble barium sa barium hydroxide. The barium sulfocyanide is converted into ammo sulfocyanide by double decomposition with ammonium sulfate.

The resulting solution is then concentrated until crystal zation sets in.

Ammonium sulfocyanide, being very hygroscopic, should be in closed vessels.

Formoguanamine - Using guanidine as a starting material, series of compounds richer in nitrogen may be obtained to which th generic name "guanamines" is given.

One of the most readily obtained is formoguanamine which corresponds to the formula

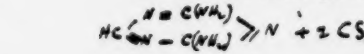


and contains 5 nitrogen atoms.

From the structural point of view this compound resembl hexamethylenetetramine, but is a pentamine.

Since it contains only three carbon atoms it is necessary to act upon it with carbon sulfide in the vulcanization process. I acts exclusively as a vitalyzer as it gives rise only to sulfocyan acid.

The reaction takes place according to the equation:



The preparation of formoguanamine is a very simple oper as the product is derived from the combination of guanidine with f acid.

Guanidine which has been studied above and is readily de from calcium cyanamide and ammonium chloride, is a very powerful b

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ld readily combines with mineral and organic acids, yielding
only the corresponding salts.

Guanidine when treated with formic acid gives guanidine
ate $CH_5N_3.COOH$ which, on being heated, loses H_2O, CO_2 and NH_3,
gives rise by condensation of two molecules of guanidine formate,
form a guanamine $C_3H_5N_5$.

An entire series of homologous guanamines may be ob-
ed by substituting for the hydrogen of the CH group an alcoholic
ile such as, for instance, acetoguanamine

$$CH_3C\begin{matrix}/N=C(NH_2)\\ \backslash N-C(NH_2)\end{matrix}\gg N$$

ioguanamine

$$CH_3-CH_2-C\begin{matrix}/N=C(NH_2)\\ \backslash N-C(NH_2)\end{matrix}\gg N$$

Propioguanamine acts as vitalyzer-accelerator without
assistance of carbon disulfide giving rise to sulfocyanic acid and
gen sulfide according to the equation:

$$H_3-C\begin{matrix}/N=C(NH_2)\\ \backslash N-C(NH_2)\end{matrix}\gg N+7S=5(CNSH)+2H_2S$$

This product is therefore more practical than formo-
amine.

It may be prepared by causing propionic acid to act upon
dine; the resulting propionate crystallizes readily by sufficient
igeration.

The propionate, on being heated to 180-200° C gives water,
n dioxide and ammonia, and by condensation of two of its molecules,
ioguanamine.

Biguanide or guanylguanidine - This compound corresponds
e formula

$$HN=C\begin{matrix}/NH_2\\ \backslash NHC(NH)NH_2\end{matrix}$$

It contains 5 atoms of nitrogen for two of carbon, hence
t in the process of vulcanization only in the presence of CS_2.
action takes place according to the equation:

$$HN=C\begin{matrix}/NH_2\\ \backslash NHC(NH).NH_2\end{matrix}+3CS_2=5(CNSH)+H_2S$$

biguanide — carbon disulfide

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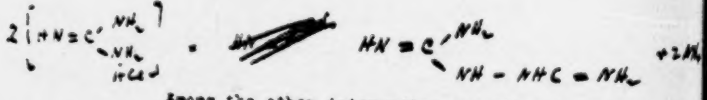
This is a vitalyzer-accelerator.

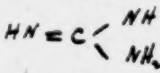
Biguanide is obtained by starting from guanidine hydrochloride. This salt is obtained by neutralizing guanidine with hydrochloric acid and concentrating the reaction product until crystallization sets in.

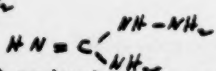
Guanidine hydrochloride crystallizes in stout white lamellae.

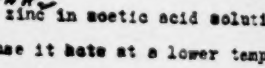
Guanidine hydrochloride, on being heated to 160-163°C., condenses two of its molecules into biguanide, by losing a molecule of ammonium chloride, according to the equation:



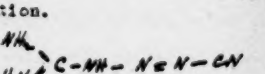
Among the other interesting guanidine derivatives which are capable of acting as vitalyzers, but are more difficult to prepare, mention should be made of nitrosoguanidine,



and of aminoguanidine  obtained by reducing nitrosoguanidine with powdered zinc in acetic acid solution, and forms an excellent vitalyzer because it acts at a lower temperature than the other guanidine derivatives.

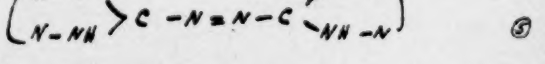
Azodicarbodiamidine: 

This compound which contains 6 nitrogen atoms results from the condensation of two guanidine molecules: it is of particular interest as a vitalyzer and acts in the presence of carbon bisulfide yielding 6 molecules of sulfocyanic acid. Unfortunately it is exceedingly difficult to prepare since one has to start from guanidine azonitrate which is a dangerous explosive.

Hydrazodicarbodiamidine 

exhibits the same difficulties of preparation.

Diazoguanidine cyanide

Azotetrazol 

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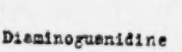
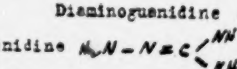
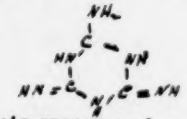
This compound contains 10 nitrogen atoms, and in the presence of formaldehyde or trioxymethylene and carbon bisulfide, might become an excellent vitalyzer: unfortunately its preparation is exceedingly delicate, and is not likely ever to be carried out on an industrial scale.

Diaminoguanidine  and triaminoguanidine  The latter substance is interesting as it contains 6 nitrogen atoms, but its preparation from ammonia, hydrogen and carbon tetrachloride is a very delicate operation.

Melamine- Melamine is a triamide derived from cyanuric acid and corresponds to the formula $C_3H_6N_6$.



It contains 6 nitrogen atoms; in presence of carbon disulfide it constitutes a vitalyzer which reacts according to the equation

$$C_3N_6H_6 + 3CS_2 = 6(CNSH)$$

Melamine + carbon bisulfide = sulfocyanic acid.

Melamine is readily prepared by polymerization of cyanamide, by heating it in an autoclave to 150° C. or else by rapidly heating ammonium sulfocyanide; it crystallises in prisms from its aqueous solutions whence alcohol or ether precipitate it as a fine powder.

Along with it three other compounds, likewise of interest as possible vitalyzers, always are formed. These are: melam $C_6H_6N_{10}$ which contains 10 nitrogen atoms $C_6H_6N_{10}$ which contains 11 nitrogen atoms; and melon $C_6H_3N_9$.

These compounds are formed when ammonium sulfocyanide is heated between 150 and 250°C.

As results from the above account the series of amino compounds derived from urea and cyanamide is capable of yielding vitalyzers which are rich in nitrogen and, consequently, exceedingly powerful.

A. DuBosc.

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Sept. 16, 13.

Prepn of Diphenyl naphthyl guanidine. Ex P

Ex

Object - Howes thought that the above compd. sub
might result from the boiling of the AN mixture, th
as the activity of the boiled mixture was found to be
greater than that of the mix. mixed heated
was desired to prepare the above substance in the p
state and try it against AN mixture

Process - The following method as given

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Beilstein II, 604, was used. (2)

14.3 g of α-naphthalamine and 22.8 g of β-carbamilide were dissolved in 500 cc. alcohol, and 30 g. PbO. added. The mixture was boiled in a ~~Erlenmeyer~~ for 3 hrs. No NH3 was given off. At the end of this time the major portion of the alcohol was distilled off and the substance allowed to crystallize out. The reaction was by no means quant. as only 6.0 gm of substance (m.p. 168°C) was obtained. It was a pure white, extremely light powder. The

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Purpn. of Diphenylnaphthylguanidine.

m. p. as given in Beilstein was 153°C. The remainder remained behind as a thick pink syrup.

Purpn. of Isomyde.- The white powder was made up into a compd. running ordinary V mixture as a control

	LN VII	PN. 6 VII	(94
White baryta	200	200	
Zinc oxide	200	200	
Sulphur	10	10	
Substance	6	6	

60 X 40 and 90 X 40 cures were made. Thumb tests did not show much difference between the activity of the two substances but if any was present the LN was the more active

Ex 6

(5)

Preparation of Diphenyl methylguanidine.

Testing of Slabs of Slabs were tested in Schoppen with following results.

	mm	Size of test plate	Kg	Elong.	
L N III	20×40	3.75 × 35"	67.6	469	670
P.N.G. VII.	20×40	3.75"×35"	31.0	460	657

77) By heating monograph-this urea with P10 in absolute ammonia until P10 was no longer blackened. M.P. of product = 173°C.

H Cords

Def's Ex. No. D
U. S. Dist. Court,
S. D. of N. Y.
JA 2

Left Exhibit D
Oct. 1925
Mlo.

Def't 23

Relative Catalytic effect of Complexes. Related to S-Carbamide.
Preparation of the different Complexes.

Complexes were prepared by the following methods -
1.) - Technically pure.
2.) - From aniline Thiol
3.) - Mono phenyl thio urea from ph-mustard oil & ammonia
4.) - Heating NH_4CNS to 130° & cooling. fractionally.
5.) - By Condensation of ph-mustard oil prepd.
6.) - By heating S-carb. in alcoholic media. soln.
with PbO until latter was no longer blackened.

(35

Relative catalytic effect of benzyls. Related to S-test.

Other effects

Phenyl mustard oil found to be inactive.

A mixt. of equal mols. of aniline & the mustard oil, equal to 3% of the rubber, was active only to the extent of the aniline present.

A mixt. of equal mols. of aniline & S-carb equal to ($1\frac{3}{4}$ % TE) $3\frac{1}{2}$ % of the rubber was active only as to its constituents and not as to the phenyl guanidine

Ex 40

Relative bactericidal Effect of Compds. Related to 5 - Carbamidophthalic.
XI/1916.

The following formula was used to try out the activity of various substances more or less closely related to 5-carbamidophthalic —

White Cross 100
Zinc Oxide 100
Sulphur 5

The following effects were recorded and, in cases where an acidification was produced, the amt. required to give a cure in one hour equal to the cure produced by 3% 5-carbamidophthalic were as follows —

1) Aniline 3.5% 3) None through this area 1.5% (151 7-9)
2) 5-Carbamidophthalic 3.0% 4) This area 1.0 % (+) (area

5) Tri phenyl guanidine (SO) = 1.75%
6) Di " " = 0.25% - (146 6)
7) mono " " = 0.25% - (191-194)

Other Effects -

Phenyl mustard oil = inactive.

A mixture of equal mols. of aniline & phenyl mustard oil, equal to 3% on rubber, was active only to extent of aniline present.

A mixture of equal mols of aniline & S-carb equal to 3½% on rubber was active only to the extent of the S carb present.

Ex. 10.

Relative Catalytic Effect of Compds. more or less Closely Related to (3- Chloranil.

~~Cl₂DK~~. — M. T. TR. Leo. XI 1/11.

The following formulae was used to try out the activity of various substances more or less closely related to 3 Chlor

White Para 100
Zinc Oxide 100
Sulphur 5

The following effects were ~~observed~~ recorded and, in cases where an acceleration was produced, the amts. req'd to give a cure in one hr. equal to the cure produced

by 3% of S-Cerv., were as follows —

Urine	
24 hours Thio urea	= 3.5%
urine " "	= 5.0
Thio urea	= 1.5
24 hours guanidine (α)	= 1.0 (+)
" " (urea)	= 1.75
urine "	= 0.25
urea	= 0.25
	= 0 33

Ex 10

952

Oct. 31, 46.

Not.

Relative Catalytic Effect of Various Sulphur Compounds.

As S-carbamide gave a cure on the following compd. in 60×5·0 idea was to determine the amounts of the other substances necessary to be used in order to give same cure in same time.

	S.C.	P.S.C.	T.P.G.	A.	A+P.M.O.	A+S.C.	
White Para	200	200	200	200	200	200	200
Zinc Oxide	200	200	200	200	200	200	200
Sulphur	10	10	10	10	10	10	10
Substance	6	3	3·5	—	—	—	—
A.	—	—	—	7	2·5	2·2	1·1
P.M.O.	—	—	—	—	3·5	—	—
S.C.	—	—	—	—	—	5·8	2·9

	T.U. (M.P. 168°C)	D.P.G.	D.P.G. I.	D.P.G. II.	D.P.G. III.
White Para	200	200	200	200	200
Zinc Oxide	200	200	200	200	—
Sulphur	10	10	10	10	10
Substance	2	3	1	0·7	0·7

D.P.G. I. = M.P. of 147°C.
D.P.G. II. = M.P. of 149°C.
" III. = " " - .
" IV. = " " - .
M.P.G. V. = " " 173°C.
D.P.G4 = " " 157°C

D.P.G. V.	M.P.G.	D.P.G4
200	200	200
200	200	200
10	10	10
0·5	0·4	3

Of the White polymer products.

DF 1/12.

Exh.

Relative Catalytic Effect of Compounds Related to Sulpho Carbamide.

The following formula was used to try out the activity of various substances more or less closely related to sulpho-carbamide.

White Para	100
Zinc oxide	100
Sulphur	5

The following effect was recorded and, in cases where all accelerator was produced, the amounts used to give a cure in one hour equal to that produced by 3% of S-Carb., were as follows—

Aniline	=	3.5%
Di phenyl thio urea	=	3.0%
Mono- " "	=	1.5%
Thio urea	=	1.0% (+)
Tri phenyl guanidine (DC)	=	1.75%
Di phenyl guanidine (Lyon.)	=	0.25%
Mono-phe- guanidine urea	=	0.25%
	=	0.33%

Other agents —

Phenolised mustard oil = Inactive.

A mixture of equal mols. of aniline & phenolised oil, equal to 3% of the rubber, was active only to the extent of the aniline present.

A mixture of equal mols. of aniline & S- was equal to 3½% of the rubber was active only to the extent of the S-Carb. present

Nov. 3, 1916.

WAK.

Preparation of Di Phenyl Guanidine.

Prepn. carried on on the basis of the following reaction—

$$\begin{matrix} C_6H_5NH \\ C_6H_5NH \end{matrix}\!\!>C\!\!< + PbO + NH_3 \rightarrow PbS + H_2O + \begin{matrix} C_6H_5NH \\ C_6H_5NH \end{matrix}\!\!>C\!\!<NH.$$

228 (30) 223 211 (27.77)

30 g. of S-carbanilide was dissolved in 225 cc. strong alcoholic ammonia and 175 cc. of 95% alcohol and 30 g. of PbO was added to the S-carbanilide soln. and the mixture heated to gentle boiling for several hours.

At the end of this time the blackened PbO (PbS) was filtered off and a fresh 30 g. portion of PbO added. Boiling continued and allowed PbO stand over night; PbS filtered off. Fresh PbO added (20 g.) and boiling recontinued. The third portion of PbO did not blacken. soln. filtered free from PbS & PbO and concentrated. Taken down to a 200 cc. & no crystals yet in soln.

Di-ph-guanidine is supposed to be sol in alcohol 1:10

Recrystd. several times from alcohol; came out in beautiful large flat needles or prisms. Melted sharply @ 147°C.

The batch from engine melted @ 149°C.

Mar. 7, 1916.

BSK.

Preparation of Di-phenyl-Guanidine from Diphenylcyanamide. (Carbodiphenylimide.)

$C_6H_5NH_2$ / $C_6H_5NH_2$ > C.S. + PbO → PbS + H_2O + C_6H_5N / C_6H_5N > C

(228) (223) (194)

(30) (30) (25)

30 g. S-carbanilide were dissolved in 250 cc. of pure benzol, 30 g. PbO added and the mixture heated on the water bath under a reflux for several hours. At end of this time the blackened PbO was filtered off, & ftd. several times with benzol, a second 30 g. portion of PbO added to filtrate, and boiling continued several hrs. longer. Then filtered, PbO ftd. with benzol and the benzol distilled from filtrate.

(X) The residue after distn. of benzol was a clear colored syrup (19 g.) which polymerized spontaneously to a white substance. Before this polymerization took place, however, an ether of NH_2 Aff was added and the mixture well stirred. 16 g. of the syrup was used for this & 3 g. left for further observation on polymerization.

Yield of carbodiphenylimide = 19.0 g = 76% Theory

X) — See next Pg.

4 — Reaction did not take place in desired manner. Then used ale. ammo with better results.

Nov. 21, 1914

Hoyt

Prepn. of Di-Ph-Guanidine (III.)
from
Diphenyl cyanamide.
(Carbodiphenylimide.)

Addition of NH_3 to
Diphenyl cyanamide —

Upon the ammonia(gas) could be added to the cyan., a partial polymerization of the latter was found to take place. After NH_3 had apparently not reacted with the diphenylcyanamid in 24 hrs., 24 cc. of alcoholic ammonia was added, with apparently little result. The resulting solid was then crystallized from alcohol fractionally and found in the main to be unchanged polymer & the cyan. supposed to be diphenyl-cyanamide, and melting therefore @ 157° C. (the same M.P. as obtained by the original boiling diphenylcyanamide on which a M.P. of ... after purification)

Another product melting @ 182-188° was also formed in lesser amount

ADK

Nov 10/37

On a cheap grey Tube for Special Brands.

Idea was to get a cheap grey tube that could be sold in competition with the British cheap tube. Tube would Horny.

	#62	#63	#63 Mod	
Smoked Rub	—	150	150	✓
Tube	300	150	150	✓
H.G.	100	100	100	✓
Brown Lub	40	40	40	✓
M.R.	40	40	40	✓
Spun Ox.	11	10	10	✓
Opaque Tube	21	30	30	—
Cellophane	29	30	30	—
# 40	2	2	2	?
Mannox R	35	1	—	
Paraffin	15	5	5	
Molyprene	—	1	3	✓
	546	537	550	

* Opaque - 2.0
* Highlite 02.

	#63	#63	#63 Mod
Burn	#1 Strip	5 Person	5 Person
A.A.	1.08	1.10	1.10
Rel. Hum.	52.57	52.59	52.8

#63 – Homeland will use some be #40 cure.
#63 Mod. – Called T.M.B.

Ex. No. G
U. S. Dist. Court.
S. D. of N. Y.
JAN 2

251

Defendant's Exhibit T (Page 1)

MEMORANDUM SHIPPING ORDER

THE FALLS RUBBER COMPANY

ORDER NO. A_____

DATE BILLED_____

Form 1P

Ship to _____ Date _____

Address _____

Via _____

Terms 1

Bill to _____

E-G
8W-23

Quantity	Size	DESCRIPTION	Price	Discount	Extension
100	28 X 3	Grey Tube	x 6		
400	32 X 3½	"			
100	31 X 4		12		
400	33 X 4				
		(Price 50 % off list)			

9/4/17

Issued by _____ Approved _____

7168

SHIPPING ORDER

THE FALLS RUBBER COMPANY

CUYAHOGA FALLS, OHIO

No. A 12546

DATE Sept. 4, 1917

Customer's Order No. [illegible] Date of Customer's Order 9/4/17

SHIP TO Rubber City Clearing House,

BILL TO [illegible], O.

TERMS Credit

SHIP VIA	QUAN.	SIZE	DESCRIPTION	PRICE	SEP 13 1917 SHIPPED	AMOUNT	BALANCE	SEP 15 1917	
	100	28x3	Grey Tubes		0		100	27	73
	400	32-3½	" "		30		270	119	237
	100	31x4	" "		0		100	53	47
	400	3524	" "		46		254	115	239
							924		
			Less 50-5% Miller List						
			Hold						
			Clearance 28 Tubes						

Ex H
634-7

Defendant's Exhibit T (Page 2) 252

656

SHIPPING ORDER

THE FALLS RUBBER COMPANY

CUYAHOGA FALLS, OHIO

No. A 12840

DATE Sept. 20, 1917 SHIP TO Rubber City Clearing House,
Customer's Order No. Book Order - 18546 BILL TO Akron, O.
Date of Customer's Order

TERMS Cash

SHIP VIA To be called for

SEP 26 1917

QUAN.	SIZE	DESCRIPTION	PRICE	SHIPPED	AMOUNT	BALANCE
73	28x3	Troy Tubes	2 95	73		0
251	32x3½	" "	3 85	251		0
47	31x4	" "	4 85	47		0
239	33x4	" "	9 10	239		0
610						

Less 50-5% Miller last

OK

Def't Ex. No. 2
U. S. Dist. Court
N. D. of N. Y.
JAN 9 1918

0936

PHYSICAL TEST SHEET

Date 11/28/01 Observer [illegible]

Lab. Test No.	Number and Formula of Compound	Cure: Time Hrs	Cure: Time Min	Cure: Press Lbs	Dimensions of Test Piece: Thickness	Dimensions of Test Piece: Width	Breaking Strain: Pounds	Tensile Strength: Pounds per Square Inch	Tensile Strength: Average	Elongation: Actual	Elongation: % Original Length	Permanent Set: Actual	Permanent Set: % Original Length	Remarks
	T-63		30	50	2/64	3/64	34	1186.6	1268.0	7 1/2		4/32	12.5	
			↓	↓	2/64	4/64	40	1396.0		7 1/2		5/32	15.6	
					2/64	4/64	35	1221.5		7 1/2		5/32	15.6	
	T-63		45	50	2/64	4/64	40	1396.0	1630.3	7 1/2		4/32	12.5	
			↓	↓	2/64	4/64	50	1745.0		7 1/2		5/32	15.6	
					2/64	4/64	44	1535.6		7		5/32	15.6	
	T-63		60	50	2/64	4/64	44	1586.0	1691.2	9		5/32	15.6	
			↓	↓	2/64	4/64	56	1764.0		7 1/2		6/32	25.0	
					2/64	4/64	56	1612.4				6/32	18.75	

Ex. No. K
U. S. Dist. Court
S. D. of N. Y.
JAN 3 - 23

Defendant's Exhibit U

254

11/3/25 AC

Comp'd #63-B

Smoked sheet	150
Latex	150
H. G. Reclaim	100
Brown Substitute	40
Mineral Rubber	40
Zinc Oxide	10
Blanc Fixe	30
Sulphur	30
Carbon Black	2
Paraffin	5
Magnesium Oxide	1
	558

Compound No. 63 A

Date 10-12-25

Object of Test

Change Made

How Replaced

Tests: Thumb / Tooth / Puncture

Sp. Gr.

Ash

Compounded by

PHYSICAL TESTS DATA

Date of Test 10-12-25

CURE	TENSILE	~~FINAL~~ ELONG.	SET
Lighter.	1858	688	
Cream.	1845	725	
Av.	1852	707	

Remarks

Tested by J. F. McWhorter

J.F.M.
10-12-25

Comp'd 63A

Smoked sheet	150.
Latex	150.
H. G. Reclaim	100.
Brown Substitute	40.
Mineral Rubber	40.
Zinc Oxide	10.
Blanc Fixe	30.
Sulphur	30.
Carbon Black	2.
Paraffin	5.
Magnesium Oxide	1.
D.P.G.	0.2
	558.2

Compound No. 63 B

Date 10-12-25

Object of Test

Change Made

How Replaced

Tests: Thumb / Tooth / Puncture

Sp. Gr.

Ash %

Compounded by

PHYSICAL TESTS DATA

Date of Test 10-12-25

	CURE	TENSILE	~~FINAL LENGTH~~ Elong.	SET
	Lengthwise	1428	685	
	Crosswise	1426	720	
	Average	1427	703	

Remarks

Tested by J.F. McWhorter

Defendant's Exhibit X (Page 4)

259 **Defendant's Exhibit AA**

9

Defendant's Exhibit BB 260

9

261 **Defendant's Exhibit CC**

DIPHENYL
DIPHENYL
GUANIDINE
GUANIDINE

ACTION OF ORGANIC ACCEL.
ACTION OF ORGANIC ACCEL

DIPHENYL
DIPHENYL
GUANIDINE
GUANIDINE

N E N

263 **Defendant's Exhibit DD-1**

971

E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. 486 Date Compd. 2/24/25 Date Tested 3/27/25 Date Reported 3/30/25

Formula

Smoked Sheet	50
Para Crepe	50
sulfur	3.5
Zinc Oxide	3.0
Dr calcined magnesia & Carbonate	0.75

SUMMARY OF PHYSICAL TEST DATA

Cure Minutes	Cure Temp	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
30	286°F					76					880	1010	
45	286°F					50					1360	980	
60	286°F					106					1410	970	
90	286°F					147					1850	950	

Remarks

Defts. Exhibit GG
Oct/25
mls

GG

Reported by E. I. Bridgwater

Defendant's Exhibit GG 264

972

Form 1960 21 - 31

DU PONT

E. I. DU PONT DE NEMOURS & CO., INC.

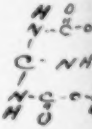
DYESTUFFS

Dyestuffs Department, Rubber Laboratory

Compound No. 519 Date Cured 9 12 25 Date Tested _____ Date Reported 9 12 25

Formula

Smoked Sheets	50
Amber Crepe	50
Zinc Oxide	3
Sulphur	3.5
Dicarbobenzyguanidine	0.75



SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resilience by Ver
60	145°C				NO Cure								

Remarks

Defts' Exhibit H H
as of 1925
mfg.

Reported by E R Bridgwater

Defendant's Exhibit HH (Page 1)

DU PONT

E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

DU PONT DYESTUFFS

Record No. 522 Date Cured 9-15-25 Date Tested Date Reported 9-18-25

Smoked Sheets	50.	
Amb. Crepe	50.	
Zinc Oxide	3.	
Sulfur	3.5	C=NH
di benzoyl guanidine	0.75	N-C-O

SUMMARY OF PHYSICAL TEST DATA

Cure Hrs.	Cure Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
60	145°C				NO cure								

Reported by E. L. McQuaig

Defendant's Exhibit HH (Page 2) 266

974

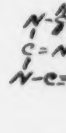
E. I. du Pont de Nemours & Co., Inc.

Dyestuffs Department, Rubber Laboratory

Compound No. 520 Date Compd. 7-15-25 Date Tested ——— Date Reported 9-15-25

Formula

Smoked Sheets	50	
Para Crepe	50	
Zinc Oxide	3	
Sulfur	3.5	
2 Hydroxymethyl 2 cyano guanidine	0.75	



SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resilience by Tor
60	145C				1/10.	Cure							

Remarks

HH

Reported by E R Mcguarke

Defendant's Exhibit HH (Page 3)

E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. 526 Date Mixed 9-18-25 Date Tested _____ Date Reported 9-18-25

Formula

Smoked Sheets	50	
Amber Crepe	50	
Zinc Oxide	3	
Sulfur	3.5	
di-sulfo-Phenylguanidine	0.75	

SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
60	141°C			NO CURE									

Remarks

HH

Reported by E. J. Midgley

976

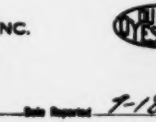
E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. 525 Date Compd. 7-16-25 Date Tested _____ Date Reported 7-18-25

Formula

Smoked Sheets	50
Amber Crepe	50.
Zinc Oxide	3.
Sulfur	3.5
Di-thio. carbothoxyguanidine	0.75



SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resilience % Rec
60	141.5°C			110	cure								

Remarks

HH

Submitted by E R Bridgwater

Defendant's Exhibit HH (Page 5)

9317

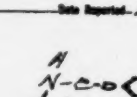
E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. 523 Date Cured 7-16-25 Date Tested Date Reported 7-18-25

Formula

Smoked Sheets	50
Amber Crepe	50
Zinc Oxide	3
Sulfur	3.5
Di-nitro dibenzoyl guanidine	0.75



SUMMARY OF PHYSICAL TEST DATA

Cure Minutes	Cure Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
60	144 SR				NO cure								

Remarks

Reported by E. L. Bridgwater

978

DU PONT

E. I. du PONT de NEMOURS & Co., Inc.

Dyestuffs Department, Rubber Laboratory

DUPONT DYESTUFFS

99

Compound No. Ed 1 B Date Cured 9 11 25 Date Tested 9 11 25 Date Reported 9 11 25

Formula

Phila no 67 (C. Shedden)	70.
Brazil Crepe	5.
Lime	1.
sulfur	4.
Barytes	18.
tri-phenyl guanidine	2.

SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resilience % Rise
15	274°F										672	8.6"	
											854	9.6"	
											742	8.8"	
									average		756	9.0"	

Remarks

Reported by E R Bridgwater

Defendant's Exhibit II (Page 1)

979

DU PONT

E. I. DU PONT DE NEMOURS & CO., INC.

DU PONT DYESTUFFS

Dyestuffs Department, Rubber Laboratory

Compound No Ed-1 Date Cured 9-17-25 Date Tested 9-17-25 Date Reported 9-17-25

Formula

Phila. no 67 (C Stokely)	70.
Brown crepe	5.
Lime	1.
sulfur	4.
barytes	18.
di. thiocarbanilide	2.

SUMMARY OF PHYSICAL TEST DATA

Cure Minutes	Cure Temp	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
[redacted]													
45	274 F										657	7.6"	
											778	8.4"	
											702	7.6"	
									average		712	7.8"	

Remarks

Reported by E R Bridgwater

980

Form 1965 2M 9-24

DU PONT

E. I. DU PONT DE NEMOURS & CO., INC.

DUCO & DYESTUFFS

Dyestuffs Department, Rubber Laboratory

Compound No. E & L-A Date Cured 9-17-25 Date Tested 9-17-25 Date Reported 9-17-25

Formula

Phila No. 69 (C Shoddy)	70.
Brown crepe	5.
Lime	1.
sulfur	4.
barytes	18

SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Rubber in Tire
15'	274°F										585	9.2"	
											640	9.8"	
											765	9.9"	
									average		663	9.63"	

Remarks

II

Reported by E L McGavack

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Defendant's Exhibit II (Page 3)

E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. Ed 2 B Date Cured 9-17-25 Date Tested 9-17-25 Date Reported 9-17-25

Remarks		
	Phila Lehigh (Yahoola)	68.
	Hydrolene	10.
	Turpentine	3.
	Fossil flour	12.
	Mroda	1.5
	Limo	225
	Sulfur	225
	tri-phenyl guanidine	1.0

Df 4 MM 10/15/25 NC.

SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resistance to Tear
20	274°F										728	240%	
											666	300%	
											705	300%	
								average			700	287%	

Remarks

Reported by E. R. McGwaker

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Defendant's Exhibit MM (Page 1)

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E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. Ed 2 Date Cured 9-17-25 Date Tested 9-17-25 Date Reported 9 17 25

Formula

Phila Lehigh (Schaadly)	68.
Hydrolene	10.
Turpentine	3
Rosin Flour	17
Carb. Black #1 (Incorp.)	1.5
Lime	2.25
Sulphur	1.0

SUMMARY OF PHYSICAL TEST DATA

CURE Minutes	CURE Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Reaction to Ice
20	274°F										51.7	3.7	
											648	38	
											646	37	
								average			620	3.73	

Remarks

FMM

Reported by: E R Bridgwater

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Defendant's Exhibit MM (Page 2)

E. I. DU PONT DE NEMOURS & CO., INC.

Dyestuffs Department, Rubber Laboratory

Compound No. Ed 2-A Date Mixed 9-17-25 Date Tested 9-17-25 Date Reported 9-17-25

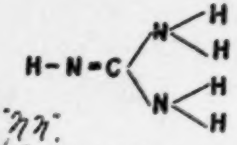
Basis Phila Lehigh (Schedly) 68.
Hydrocarbene 10.
turpentine 3.
Rosin flour 12.
Inverted Carbon black 1.5
lime 2.25
sulfur 2.25

SUMMARY OF PHYSICAL TEST DATA

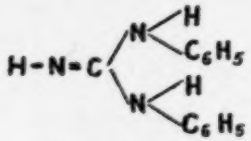
Cure Time	Cure Temp.	100%	200%	300%	400%	500%	600%	700%	800%	900%	Tensile Strength	Elongation at Break	Resilience by Tele
20	274°F										473	4.0"	
											505	4.2"	
											482	4.0"	
							average				487	4.07"	

Reported by E. K. Bridgwater

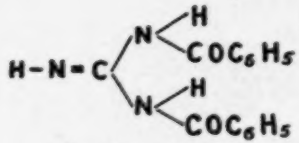
Defendant's Exhibit MM (Page 3)



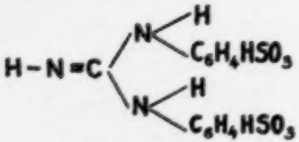
Guanidine



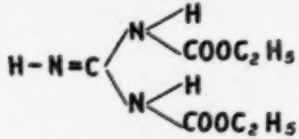
Diphenylguanidine



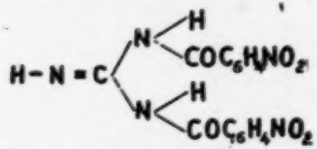
Dibenzoylguanidine



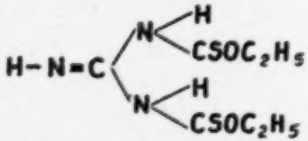
Disulphophenylguanidine



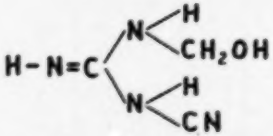
Dicarbethoxyguanidine



Dinitrodibenzoylguanidine



Dithiocarbethoxyguanidine



Hydroxymethylcyanoguanidine

C Represents Carbon N Represents Nitrogen H Represents Hydrogen S Represents Sulphur O Represents Oxygen.

C_6H_5 Represents Phenyl group COC_6H_5 Represents Benzoyl group $C_6H_4SO_3$ Represents Sulphophenyl group

$COOC_2H_5$ Represents Carbethoxy group $COC_6H_4NO_2$ Represents Nitrobenzoyl group

$CSOC_2H_5$ Represents Thiocarbethoxy group CH_2OH Represents Hydroxymethyl group C N Represents Cyano group

—(Lines) Represent "Valences" or bonds between atoms

Defendant's Exhibit NN

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UNITED STATES PATENT OFFICE.

FRITZ HOFMANN AND KURT GOTTLOB, OF ELBERFELD, GERMANY, ASSIGNORS TO SYNTHETIC PATENTS CO., INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VULCANIZATION OF RUBBER AND PRODUCTION OF VULCANIZED-RUBBER PRODUCTS.

1,126,469. Specification of Letters Patent. Patented Jan. 26, 1915.

No Drawing. Application filed October 16, 1913. Serial No. 795,506.

To all whom it may concern:

Be it known that we, FRITZ HOFMANN and KURT GOTTLOB, doctors of philosophy, chemists, citizens of the German Empire, residing at Elberfeld, Germany, have invented new and useful Improvements in Vulcanization of Rubber and Production of Vulcanized-Rubber Products, of which the following is a specification.

In the applications, Serial Nos. 688761 and 688762, filed April 5, 1912, there are described new caoutchouc substances and the vulcanization products thereof, which are obtained by treatment of the autopolymerization product of beta-gamma-dimethylerythrene with basic substances and by subsequent vulcanization of the resulting products.

In our companion application Serial No. 795,506, filed October 16, 1913, we have described that among these basic substances certain methylene bases, either open carbon chain or closed carbon chain bases, such as tetramethylenediamin, pentamethylenediamin, beta-beta-dimethyl-delta-methyltrimethyleneamin derivatives, and the urea and carbon bisulfid derivatives of bases such as dimethylamin, as well as piperidin, methylpiperidin, n-thiopiperidin, benzaldipiperyl, piperidyldithiocarbamidate or piperidin, monopiperidyl urea, and in particular the solid and liquid derivatives of piperidin and its homologues which have no odor and only a faint odor, lend themselves excellently for the production of vulcanization products from polymerized beta-gamma-dimethylerythrene, and particularly from the autopolymerization product of this hydrocarbon.

We have now discovered that the vulcanization of rubber generally, either natural or synthetic, can be materially promoted by the use of such a methylene base and particularly by the use of a piperidin base, etc.; and that by the use of such a base the vulcanization process proceeds more smoothly and more quickly while an improved product is obtained. The present invention is accordingly generic in its nature to the vulcanization of natural and synthetic rubbers.

According to the process of the present invention the rubber, either natural or synthetic, is treated either before or simultaneously with the addition of sulfur or of other vulcanizing agents with a methylene base and more specifically with a methylene base which is not fugitive at the temperature of vulcanization, and the base is thus incorporated within the mass and remains therein combined either physically or chemically. Among such bases may be mentioned the saturated aliphatic amins and their derivatives (both open carbon and closed carbon chain compounds) such as tetramethylenediamin, pentamethylenediamin etc. which are saturated methylene open carbon chain bases, beta-beta-dimethyl-delta-methyltrimethyleneimin and its urea derivatives, the urea and carbon bisulfid derivatives of such bases as dimethylamin, etc., the carbon bisulfid derivative of pyrrolidin (tetrahydropyrrol), and as particularly valuable bases there may be mentioned piperidin (hexahydropyridin), its derivatives and homologues, etc., such as methylpiperidin, n-thiopiperidin, benzaldipiperyl, pipiperidyldithiocarbamidate of piperidin, monopiperidyl urea, etc., and in particular those solid and liquid derivatives of piperidin and its homologues which have no odor, or only a faint odor.

The term methylene base is used as generic to those bases which are saturated bases as distinguished from unsaturated bases such as anilin or pyridin, and which are not fugitive at the vulcanization temperature, and this term is intended to include as a generic term non-fugitive open carbon chain bases and closed carbon chain imino bases such as piperidin, etc. By the use of these bases, and particularly by the use of piperidin the vulcanization not only proceeds more quickly and more smoothly, but it is also possible to obtain either an improved vulcanized soft or hard rubber product.

The rubber used in the present invention to form the vulcanized hard or soft rubber product may be either natural or synthetic. In certain respects the synthetic rubbers differ from the natural rubber and the vulcanization problems presented are in many cases peculiar to the synthetic rubbers. The synthetic rubber are normally free from such nitrogenous constituents and such resins as are normally present in natural rubber. Frequently also the synthetic rub-

Defendant's Exhibit NN

bers contain more or less of the dimeric hydrocarbons or polymerization products produced at the same time as the synthetic rubber, which are on the other hand absent in natural rubbers. The vulcanization process appears in many cases to be materially affected by the presence or absence of these heterogeneous substances, but the process of the present invention is nevertheless of general application in the vulcanization of natural rubber, and of synthetic rubbers obtained by the polymerization of rubber-yielding hydro-carbons, such as the butadiene series among which there may be mentioned isoprene, erythrene, beta-gamma-dimethyl-butadiene etc.

The following examples further illustrate the novel process and the production of the novel products according to the present invention:—

Example 1: 100 parts of Pará-rubber are mixed with 10 parts of sulfur and 0.5 parts of piperidin and heated for 15 minutes to 135–145° C. (3½ atmospheres). In this way a soft vulcanized product is obtained which contains 3.5 per cent. of combined sulfur. In the absence of piperidin the reaction requires about 1 hour. If Pará-rubber is substituted by synthetic rubber, corresponding results are obtained.

Example 2: 100 parts of Pará-rubber and 10 parts of sulfur and 1.5 parts of piperidin are heated at 120–125° C. (2½ atmospheres) for 1 hour. A well vulcanized product is obtained. Without piperidin Pará-rubber gives an unfinished mass of little value under the same conditions.

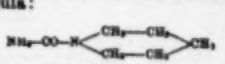
Example 3: 100 parts of erythrene caoutchouc, 10 parts of sulfur and 1 part of piperidin are heated at 120–125° C. (2½ atmospheres) for 20 minutes. A vulcanized erythrene caoutchouc is thus obtained.

Example 4: 100 parts of beta-gamma-dimethyl-butadiene rubber are heated with 10 parts of sulfur and 1 part of piperidin for 1 hour at 120–125° C. (2½ atmospheres). The result is a good soft rubber substance.

Example 5: 100 parts of beta-gamma-dimethyl-butadiene rubber are heated with 40 parts of sulfur and 0.75 parts of piperidin to about 155° C. (5–6 atmospheres). After 2 hours a hard rubber product is obtained which contains about 25 per cent. of combined sulfur. Without piperidin a product is obtained under the same conditions which contains only about 12 per cent. of combined sulfur.

Example 6: 100 parts of Pará-rubber, 10 parts of sulfur and 1 part of piperidyl-dithiocarbamidate of piperidin (melting at 173° C.) are heated for 15 minutes to 135–145° C. (3½ atmospheres). An excellent soft rubber substance is obtained. A good product is also obtained if the temperature is kept at 120–125° C. (2½ atmospheres) for about 1 hour. Similar or corresponding results are obtained with synthetic rubbers or when other natural rubbers are employed.

Example 7: 100 parts of beta-gamma-dimethyl-butadiene rubber, 50 parts of sulfur and 1 part of mono-piperidylurea of the formula:



are heated to 155° C. for 4 hours (5–6 atmospheres). An excellent hard rubber is obtained. If instead of 50 parts of sulfur only 10 parts are used, and it is heated to 120–125° C. (2½ atmospheres) for 1 hour, a soft rubber product is obtained. Other synthetic or natural caoutchoucs may be used in the above example; *e. g.* isoprene rubber, erythrene rubber, etc., also sodium butadiene rubber; also sodium isoprene rubber, etc.

The piperidin compounds mentioned in the above examples can be substituted by n-thiopiperidin (*Michaelis*, Berichte 28, 1013) or by benzalpiperyl (*Journal f. prakt. Chemie* (2), Band 36, p. 130) or by other solid or liquid derivatives of piperidin or its homologues.

Example 8: 100 parts of Pará-rubber, 10 parts of sulfur, and 1 part of the addition product of dimethylamin and bisulfid of carbon are heated for 15 minutes to 130–135° C. (3 atmospheres). A well vulcanized product is obtained. Without the above substance the reaction requires over 1 hour.

Example 9: 100 parts of beta-gamma-dimethylbutadiene rubber, 10 parts of sulfur, and 1 part of tetramethylenediamin are heated for 1 hour to 120–125° C. (2½ atmospheres). A soft rubber substance is obtained.

Example 10: 100 parts of Para-rubber, 100 parts of beta-gamma-dimethylbutadiene rubber, 20 parts of sulfur and 3 parts of the urea derivative of beta-beta-dimethyl-delta-methyl-trimethylenediamin are heated for 2 hours to 155° C. (5–6 atmospheres). An excellent hard rubber is obtained. Instead of the Pará-rubber and dimethylbutadiene rubbers, other synthetic rubbers or other natural rubbers may be employed.

In the above examples the addition of the piperidin and other methylene bases materially shortens the usual time required for vulcanization. If the process is continued for a longer time, a lower temperature may be employed, or if the process is continued at the usual temperature and time of vulcanization, a larger combination of sulfur is effected and a harder product is obtained. The results thus accomplished are much more marked than when other bases such as pyridin, quinolin, dimethylanilin are present. These bases hardly possess the

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property of accelerating and improving the vulcanization.

The vulcanized rubbers obtained according to the above examples contain the sulfur of vulcanization and a small amount of the added methylene base, combined therewith, either physically or chemically or in part physically and in part chemically.

We claim:

1. The process of producing a vulcanized rubber which comprises incorporating with rubber a small amount of a methylene base, and heating the resulting product with a vulcanizing agent to effect vulcanization.

2. The process of producing a vulcanized rubber which comprises incorporating with rubber a small amount of a heterocyclic methylene base, and heating the resulting product with a vulcanizing agent to effect vulcanization.

3. The process of producing a vulcanized rubber which comprises incorporating with rubber a small amount of a piperidin base, and heating the resulting product with a vulcanizing agent to effect vulcanization.

4. The process of producing a vulcanized rubber which comprises incorporating with rubber a small amount of piperidin, and heating the resulting product with a vulcanizing agent to effect vulcanization.

5. The process of producing a vulcanized rubber which comprises incorporating with natural rubber a small amount of a methylene base and heating the resulting product with a vulcanizing agent to effect vulcanization.

6. The process of producing a vulcanized rubber which comprises incorporating with natural rubber a small amount of a heterocyclic methylene base, and heating the resulting product with a vulcanizing agent to effect vulcanization.

7. The process of producing a vulcanized rubber which comprises incorporating with natural rubber a small amount of a piperidin base, and heating the resulting product with a vulcanizing agent to effect vulcanization.

8. The process of producing a vulcanized rubber which comprises incorporating with natural rubber a small amount of piperidin, and heating the resulting product with a vulcanizing agent to effect vulcanization.

9. As a new article of manufacture a vulcanized rubber combined before vulcanization with a small amount of a methylene base.

10. As a new article of manufacture a vulcanized rubber combined before vulcanization with a small amount of a heterocyclic methylene base.

11. As a new article of manufacture a vulcanized rubber combined before vulcanization with a small amount of a piperidin base.

12. As a new article of manufacture a vulcanized rubber combined before vulcanization with a small amount of piperidin.

13. As a new article of manufacture a vulcanized natural rubber combined before vulcanization with a small amount of methylene base not fugitive at the vulcanization temperature.

14. As a new article of manufacture a vulcanized natural rubber combined before vulcanization with a small amount of heterocyclic methylene base.

15. As a new article of manufacture a vulcanized natural rubber combined before vulcanization with a small amount of piperidin base.

16. As a new article of manufacture a vulcanized natural rubber combined before vulcanization with a small amount of piperidin.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

FRITZ HOFMANN. [L. S.]
KURT GOTTLOB. [L. S.]

Witnesses:
HELEN NUFER,
ALBERT NUFER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

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VULCANIZATION ACCELERATORS.

BY S. J. PEACHEY.

[SPECIALLY CONTRIBUTED.]

In an article which appeared in a recent issue of THE INDIA-RUBBER JOURNAL as a reprint from the pages of *Metallurgical and Chemical Engineering*, Mr. A. H. King furnishes an interesting and instructive account of the present position of a comparatively new branch of rubber chemistry, viz., the employment of organic catalysts as accelerators of the vulcanizing process. The article referred to appears to be the first contribution on the subject to current English literature, and as for this reason it is likely to attract the attention of manufacturers to a highly important development in the rubber industry, the present writer feels that it is desirable to call attention to one or two important omissions from what is otherwise a most useful and exhaustive survey of the subject.

The author deals firstly with the well-known mineral accelerators, such as lime, magnesia, and litharge, and then proceeds to give a detailed account of the preparation and properties of the more recently discovered organic activators. The prototype of these is piperidine, the use of which as an accelerator was patented in Germany by Bayer and Co. in 1912. Other more or less effective agents were discovered a little later, and these receive due attention in Mr. King's article. Unfortunately the reader is left with the impression that the initiation and development of this branch of rubber research has been entirely due to the labours of German chemists.

It is quite true that in their efforts to bring about a satisfactory vulcanization of their so-called synthetic rubber (which in the strict chemical sense is not rubber at all) the Germans were led to the discovery of an agent which possesses the property of facilitating the union of rubber and rubber-like substances with sulphur, but it is equally true that by far the most satisfactory organic accelerator, judged from the manufacturer's point of view, was discovered in a British laboratory, and is now being made in a Manchester works, and employed regularly and successfully by some of the largest and best-known rubber firms in the country.

The substance referred to is known as accelerene, and consists essentially of paranitroso dimethylaniline (Eng. Pat. 4263/14). It is a compound wholly different in type from the German accelerators, in that it owes its activity to the presence of the nitroso group, and not to any feeble basic properties which it may possess. It is one of the most powerful vulcanization catalysts known; added to a rubber mixing in the proportion of one-third to one-half per cent. (0.3-0.5 per cent.) it reduces the time needed for vulcanization to *one-third* of the normal, and even this reduction does not represent the limit of its power, for if used in conjunction with certain other familiar substances a reduction to one-eighth of the normal time is readily obtained. The latter extreme reduction in the time of vulcanization is, however, not to be recommended, except in the case of quick repair compounds, but the reduction to one-third gives highly satisfactory results. Generally speaking, the best effects are obtained with medium and high-class mixings. Cheap mixings containing much reclaim or waste do not respond so readily to the catalytic action of the accelerator. In the case of mixings containing golden sulphide of antimony and little or no free sulphur it is noteworthy that the catalyst produces hardly any acceleration. In such cases a sufficient quantity of free sulphur must be added, and the percentage of antimony sulphide may then be reduced to that needed to p the desired colour to the mixing, after which the reduction in the time of vulcanization is attained.

In the manufacture of vulcanite the results obtain by the use of paranitroso dimethylaniline are very strik With the addition of 0.75 per cent. of the accelerato pure mixing of 100 parts of rubber and 40 parts of sulp may be fully vulcanized in two hours instead of the period of six, yielding a hard and very durable produc

Another point of considerable interest to manufacture is the fact that sulphuring-up may be completely p vented by the use of paranitroso dimethylaniline. order to obtain this effect, the amount of sulphur in mixing is reduced to something approaching the theore cal proportion required to yield the desired coefficient vulcanization. Thus, for example, the quantity of s phur employed may be reduced to as low a figure as to 3.5 per cent. The usual percentage (0.5) of the celerator is then added, and the mixing cured in ordinary manner. In such cases there is naturally li or no reduction in the time of vulcanization owing to diminished proportion of sulphur present. The power the catalyst is expended here in bringing about a pra cally complete combination between the molecules of rubber and of the sulphur, with the result that little o free sulphur remains in the rubber, and sulphuring becomes impossible.

Paranitroso dimethylaniline possesses one very import advantage over the other recently-discovered accelerato a fact which was first pointed out by certain firms w have tested different types of catalyst in works practi Whilst the German products undoubtedly produce a ra acceleration of the vulcanizing process, and are from t point of view quite satisfactory, they suffer from a seri drawback in that the vulcanization does not cease wh the goods are removed from the pan or the press, continues during storage, thus causing deteriorati Paranitroso dimethylaniline, on the other hand, produ an equally great acceleration, but shows no tende whatever to bring about after-vulcanization, even on p longed storage of the goods. The truth of this statem has been tested over a period of two years.

It appears also that goods vulcanized in presence of new accelerator show a somewhat greater tensile stren than those cured in the normal time. Investigations this point have not yet been completed, but a probab explanation is that the greatly reduced time of heat needed to bring about perfect vulcanization leads to diminished amount of depolymerisation, and this res in an increase in the nerve or strength of the rubber.

The above points are all of importance to the manufa turer, but the one which is likely to make the strong appeal is the fact that with the aid of these new celerators the output of an existing vulcanizing plant m be trebled at a comparatively small cost. It will probab be generally conceded that after a lapse of some thr quarters of a century a new principle has at last be introduced to the rubber industry.

The writer hopes that this brief article may suffice show manufacturers that not only in the production rubber goods does the Old Country hold its own, but i in original research on the chemistry and technology rubber it has now taken the lead.

Defendant's Exhibit "PP."

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Communication.

THE ACCELERATION OF VULCANISATION.

BY T. A. BRAZIER.

There methods are available for the speeding-up of the vulcanisation process: (1) raising the temperature, (2) increasing the proportion of sulphur relative to rubber, (3) introducing an accelerator.

Effect of temperature.

The effect of alteration of temperature is similar to that for other chemical reactions, the temperature coefficient being between 2 and 3 for 10° C. The suggestion has been made that some accelerators, lead oxide in particular, are not genuine catalysts, but that they merely react with part of the sulphur with evolution of heat, thereby raising the temperature of the reacting mass above that of the surrounding heating medium (Weil, Gummi-Zeit., 1911, 25, 710, 748). The insufficiency of this explanation is evident from the fact that such an effect should be almost negligible at the surface of the rubber in contact with the mould, whilst in the interior it would be marked; thick slabs also would vulcanise much more rapidly than thin sheets; both these consequences of the theory are contrary to experience. It is quite possible, however, that many vulcanisation accelerators do exert a slight thermal effect in addition to their purely catalytic influence.

The curves given in Fig. 1 represent results of some of our experiments as to the rate of vulcanisation at temperatures ranging from 130° C. (35 lb. steam pressure) to 160° C. (96 lb.) for a mixture of pale crêpe rubber (90) and sulphur (10); the corresponding curve for 125° C. will be found in Fig. 4. Pale crêpe rubber was chosen as showing greater uniformity in rate of vulcanisation than other forms of rubber, and was taken as far as possible from one raw. For the introduction of the sulphur a short mixing of sulphur with approximately an equal weight of rubber was used; the composition of this mixture was checked by analysis, and the correct proportion weighed out for mixing with the remainder of the rubber. In this way the almost inevitable loss of sulphur that during the customary method of mixing was avoided.

The progress of vulcanisation may be followed in at least three different ways: (a) by the combination of sulphur; (b) by the gradual decrease in the extensibility of the rubber at a definite load (or increase of the load necessary to produce a definite elongation); within the range of the experiments in this paper, this shows a roughly rectilinear relationship with the period of vulcanisation. Unfortunately, this method is influenced to a greater extent than either (a) or (c) by the mechanical treatment of the rubber during mixing and the subsequent milling operation. Increased working or heating having a tendency to exaggerate the extensibility figure. The approximation of the curve to a straight line and the close proximity of extensibility values for duplicate samples (see p. 136 T) are evidence of the considerable degree of accuracy attainable with careful working. For the purpose of comparison however different samples are stretched at 600% (doubling the original length) at a load of 0·5 kilo. per sq. cm. has been arbitrarily assumed as a standard dependent upon this paper; (c) by the time required to produce maximum tensile strength.

The last method, although of less importance than might be expected in technical practice, is of considerable value in experimental work as supplying a convenient and rapid method for comparing rates of vulcanisation, e.g., of different rubbers or at different temperatures, the maximum tensile strength determined within three days of vulcanisation, being observed with a product containing approximately 5 of combined sulphur calculated on the rubber. The actual value of the breaking strength of a rubber test piece is always more or less fortuitous; however, as vulcanisation beyond the condition necessary for the attainment of the maximum strength causes a very rapid weakening, the position of the maximum is relatively easily determined. The peaked curves in Fig. 1 indicate the position of the maximum rather than the actual magnitude of the values.

It will be observed that the temperature coefficient manifests no tendency to any regular increase or decrease with rise of temperature, the mean value calculated by all three methods of comparison) from the figures represented in the curves for the rubber-sulphur mixture at 120° to 160° C. approximating to 2·2. This appears to indicate that the alteration forms ordinarily present in molten sulphur to relative proportions dependent on the temperature, must possess equal or at least comparable vulcanising activity (see Trans. Annual Report, 1919, 4, p. 325).

The extent to which the vulcanisation period in technical work can be lessened by raising the temperature is limited by various considerations, not the least of which is the poor thermal conductivity of rubber and the consequent danger of unequal heating, involving local irregularities in the degree of vulcanisation.

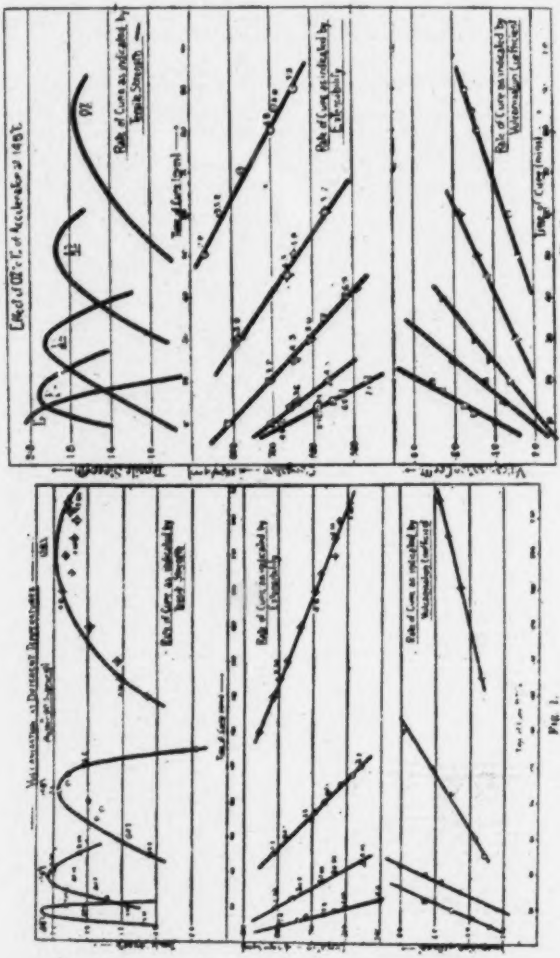
Increase of proportion of sulphur.

Many old compounding ingredients and specifics of the rubber trade, often bearing fanciful names, contained—undeclared—considerable proportions of free sulphur, mixtures of sulphur with various waxes and also with antimony sulphide may be quoted as better class examples. As the rate of vulcanisation of rubber-sulphur mixings containing less than, roughly, 10 of free sulphur is directly proportional to the percentage of free sulphur, the effect of such additional sulphur-containing ingredients on the rate of vulcanisation is obvious, and to-day is commonly realised.

For experimental work on the relative rates of vulcanisation of different rubbers or on the effect of various catalysts, the selection of a mixture of rubber and sulphur containing as much as 10% of the latter is advisable, not only because this quantity is more than sufficient to permit the progress of the change to well beyond the characteristic maximum strength, but also because it is sufficiently high to reduce to extent any disturbance arising from slight inaccuracies in the proportion of sulphur present. The possibility must always be borne in mind, however, that the activity of an accelerator may possibly be influenced by the proportion of free sulphur simultaneously present.

Use of a catalyst.

Almost all basic substances can act as catalysts to the vulcanisation process, e.g., magnesium oxide, lead oxide, lime, sodium hydroxide, potassium hydroxide, and also substances such as sodium amide, potassium glycerosside and sodium phenoxide, which, by interaction with the traces of water invariably present in rubber, are able to give rise to alkalis or bases. Typical examples of organic accelerators are piperidine, quinoline (the crude alkaloid mixture known as "quinoline" is commonly used), aniline, naphthylamine, p-phenylenediamine, hexamethylenetetramine, dimethylaniline, p-nitrosodimethylaniline, diphenylguanidine, aldehyde-ammonia, and simple carbon bisulphide or



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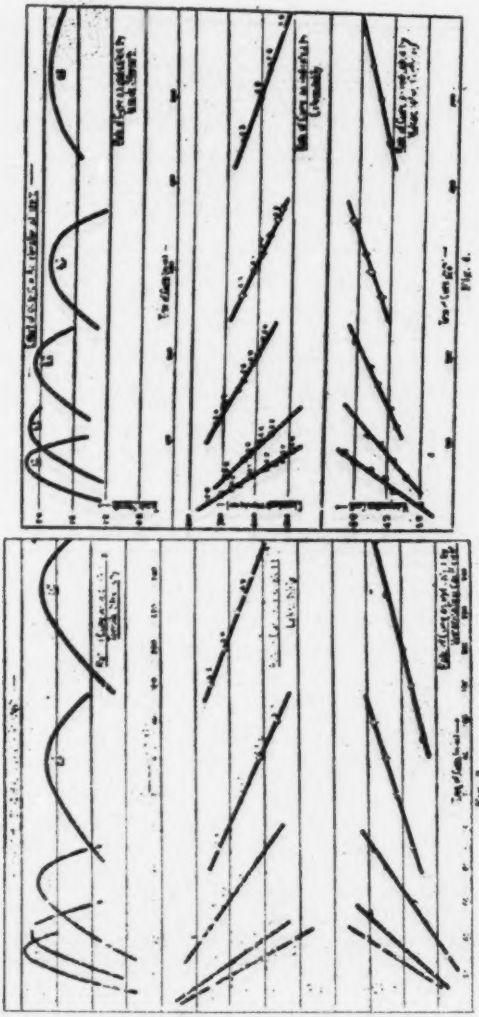


Defendant's Exhibit RR (Page 3)

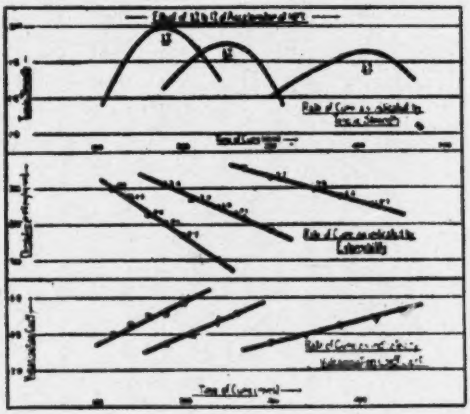


Fig. 5.

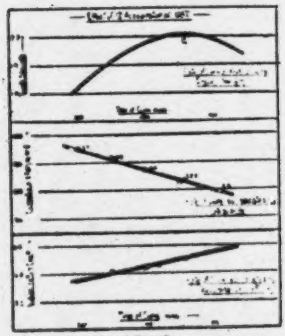


Fig. 6.

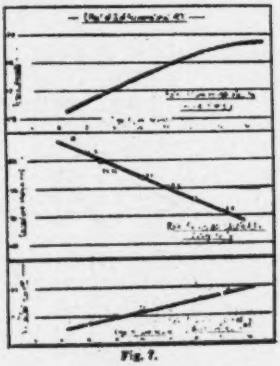


Fig. 7.

carbon dioxide derivatives of the amines, such as dimethylammonium dimethylcarbamate, the corresponding dimethyldithiocarbamate and thiocarbanilide. Compounds containing a nitro-group substituted into an aromatic cyclic nucleus are also effective catalysts, the best known example being *p*-nitrosodimethylaniline. Clearly there is a wide range of possible accelerators of these vermeer-

types.* In this connection there must also be mentioned the pre-vulcanized forming catalysts in rubber during its production. If the wet rubber

* The presence of nitrogen in all these organic substances of the connection with the detection by rubber. The nitrogen contained in a comparable extent with pure latex substances on producing vulcanization with sulphur and the extract subsequently did show an abnormally high percentage of nitrogen.

998

ties, frankly complained from the loss, is kept for several days before being rolled and crushed, partial decomposition of the nitrogenous constituents of the retained serum sets in with the formation of organic bases. These are not eliminated by the subsequent rolling and washing, so that the resulting rubber exhibits exceptionally rapid vulcanisation.

As is illustrated clearly by our results in Fig. 1, the curve representing the rate of combination of rubber and sulphur does not follow the course expected from a simple chemical reaction, but, with less than 10% of free sulphur, is approximately rectilinear until the almost complete exhaustion of the sulphur (Spence and Young, this J., 1911, 817; 1912, 81, 785). This is probably to be explained by the occurrence of supersaturation; with mixtures of rubber and sulphur containing more than 10% of the latter, the progress of the fixation of sulphur follows the sinuous S course, which is commonly regarded as characteristic of an autocatalytic process (Skelton, Rubber Industry, 1911, 1-7; van Iterson, Comm. Netherlands Govt. Lab. for Advising Rubber Trade, 1910, 7-27). In the presence of an artificial catalyst, therefore, the compensation relation between the effect of the disappearance of sulphur and the extent of the increasing catalytic effect may be disturbed, so that the fixation of sulphur no longer follows a rectilinear course (van Iterson, *loc. cit.*).

Although the results as to the rate of vulcanisation of a simple sulphur mixing, as derived by these three methods, are comparable, in the presence of an extraneous catalyst, this is not necessarily so. The chemical action of sulphur on the rubber induces the physical alterations which constitute the advantage to be gained by vulcanisation, but the chemical and physical processes are not necessarily strictly proportionate, and some "accelerators" influence one more than the other. In the presence of certain accelerators the physical or mechanical alteration is disproportionately rapid, and the tensile strength attains its maximum" at a coefficient of vulcanisation (combd. sulphur × 100 ÷ rubber) well below the normal value of 5 (see p. 1207).

Other accelerators, on the other hand, reduce the sharpness of the optimum, so that the peak of the curve is less pronounced. In art other cases the catalyst may give rise to a vulcanised rubber with an abnormal extensibility relative to its coefficient of vulcanisation. Most of them, but not all, by reducing the time of heating necessary, cause the production of a rubber with a higher tensile strength than would be obtained by mere cold rub mixation at the same temperature without the catalyst, and in this direction reduction of the time of vulcanisation by using an increased percentage of sulphur can have a similar effect (van Iterson, *loc. cit.*, p. 200).

The effectiveness of one of the above-named organic catalysts, viz., aldehyde-ammonia, is demonstrated by the accompanying curves (Figs. 2-6) representing the results of experiments made, like those given in the earlier curves, with a mixture of pale crepe and sulphur (30 : 10), at various temperatures from 134° C. (at 35 lb. steam pressure) downwards, to an oil bath subsequently. Even at a concentration of 1 : 100 the effect is still exceedingly active, with 1% vulcanisation occurs so readily as to be possible in a reasonable period at 120° C., or less than 5 lb. steam pressure, Fig. 7, indeed, records the progress of vulcanisation at 98° C. It will be seen that the *temperature coefficient* calculated by the ratio of the speed of reaction at intervals of 10° C. from 106° to 146° is *practically the same as for the reaction in the absence of an artificial catalyst* (p. 1259), the average value for the accelerated mixings represented in Figs. 2-6 being 2·6. This observation militates against the belief of some investigators in this field that vulcanisation catalysts are not themselves able to expedite vulcanisation, but that during the early stages of the process they combine with sulphur, giving rise to substances which possess the desired activity. This view may be correct in certain cases, but evidently cannot be accepted generally for all vulcanisation catalysts. The average values of the coefficient with the various proportions of accelerator are given in the table:—

Average Temperature Coefficient.

Proportion of accelerator.	15 (100 : 667 C.)	17½ (100 : 570 C.)	20 (100 : 500 C.)	25 (100 : 400 C.)	33 (100 : 303 C.)
Method of taking—					
(a) Combination with sulphur	2·6	2·6	2·6	2·6	2·6
(b) Elongation at 0·5 kilo. per sq. mm.	2·6	2·5	2·5	2·4	2·1
(c) Maximum tensile strength	2·5	2·5	2·4	2·3	2·0

It is a striking fact that although the individual values of the temperature coefficient between 106° and 146° C. without exception oscillate closely about the mean value of 2·6, the interval 96°–106° C. shows a much greater value exceeding 5·0. This is doubtless due to the melting of the sulphur between these two latter temperatures, the normal melting point being lowered under the obtaining conditions. This observation supplies a confirmation of the statement on page 1257 as to the comparable effectiveness of the various allotropic forms.

The fact observed above, that the temperature coefficient possesses comparable values for mixings with and without an artificial catalyst, appears from other results in our possession to be a general one for all catalysts. This facilitates the representation of the relative effectiveness of different catalysts by means of a numerical factor. A factor representing the ratio of the respective periods of vulcanisation required for the attainment of a definite state of vulcanisation in a rubber-sulphur mixing, with and without a definite proportion of accelerator, will be independent of the temperature, it will be essential that this comparison be made at a stage of the vulcanisation process when the mixture still contains a considerable proportion of uncombined sulphur. The resulting "acceleration factor" may differ according to which of the three possible criteria—percentage of combined sulphur, maximum tensile strength and extensibility at definite load—is taken as fixing a definite state of vulcanisation. In the case of the accelerator used in the experiments now quoted the behaviour may be described as normal, all three methods giving comparable results. The effectiveness calculated in this way for the accelerator at various concentrations and at different temperatures is given in the following table; the figures in each case represent the mean of the values obtained by the three different methods of the comparison of rate of vulcanisation.

Mixings with rates, the proportions of 5, 4, 3, and 2 per-centiles of the accelerator increase the rate of vulcanisation at any temperature vulcanising temperature to 1·7, 2, 3, and 7½ times the normal. A

Defendant's Exhibit RR (Page 5)

"Acceleration factor."

Percentage	½	1	1½	2
Temperature:				
130°–140° C.	37	56	51	75
135°–145° C.	37	56	54	74
140°–150° C.	37	50	60	71

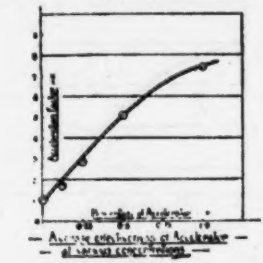


Fig. 8.

Fig. 8. The slight divergency (from the course of the smooth curve) of the points for the lower percentages is doubtless due to the relatively greater effect of the inevitable small loss of accelerator by vaporisation during the mixing operation.

Fig. 9 includes curves showing the relative effectiveness of isomeric substances, viz., *m*- and *p*-phenylenediamine as accelerators. The meta-compound is notably less active than its para-isomeride. It is of interest to note that the effectiveness of these two substances towards vulcanisation falls in the same order as their affinity constants as determined by Brodie in 1851. The low value of the coefficient of vulcanisation at the maximum tensile strength of the *p*-phenylene-diamine mixing will also be noticed. The absence of points on the extensibility curve beyond a co-efficient of 4 is due to the samples concerned being over-vulcanised and too weak for the test.

In Fig. 10 are given the results of tests on four different occasions and with three separate mixings, containing 1% of *m*-phenylenediamine; they are of importance, particularly in the extensibility section, as demonstrating the comparableness of figures obtained, even in independent experiments, with the standardised conditions adopted in this investigation.* The "acceleration factor" for *m*-phenylenediamine, calculated from the results in Fig. 8 has a mean value of approximately 1·5; for *p*-phenylenediamine judged by the physical methods the factor is approximately 3·3, whereas the rate of combination with sulphur indicates a value of only 3·0.

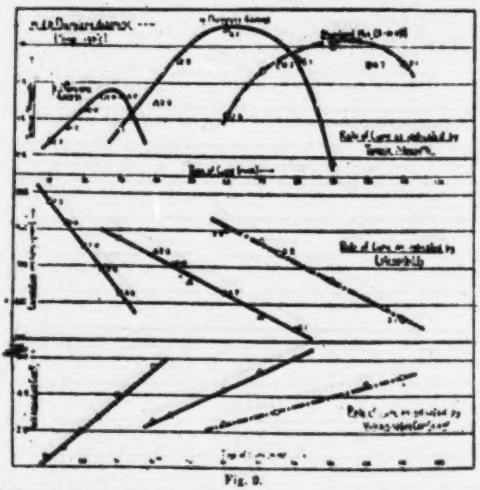
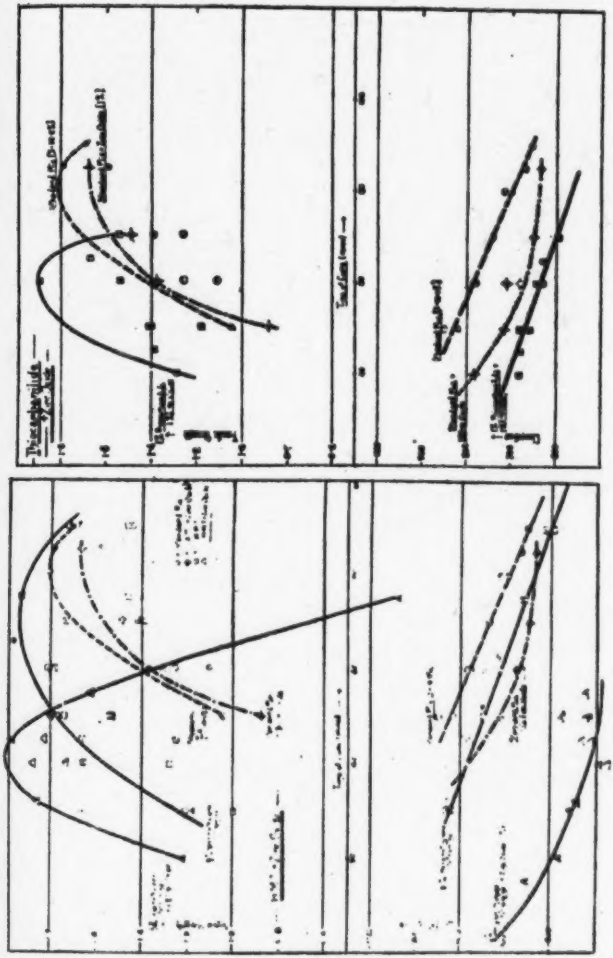


Fig. 9.

graphic representation of this result as to the relation between the proportion of the accelerator in question and the effect produced is given in

* In these and the previous experiments vulcanisation was effected by immersing the mixed rubber, enclosed in suitable moulds, in oil at the required constant temperature.



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Mixed Catalysts.

The effectiveness of a mixture of catalysts in an ordinary chemical reaction is well known not to coincide invariably with the sum of the effects produced by each independently. This peculiarity is also observable with vulcanisation catalysts (Heinze, *Gummi-Zeit.*, 1913, **28**, 120). Lead oxide with magnesium oxide, and β-naphthylamine-hydrochloride with another of one of its homologues, are cases which have already been quoted in the literature.

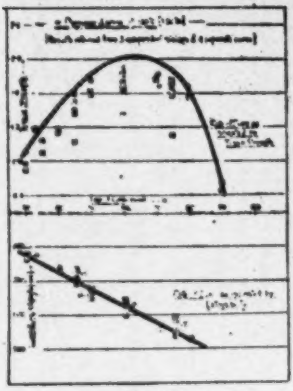


Fig. 10.

A related phenomenon probably is also the power of zinc oxide, which alone does not work rubber vulcanisation, to increase considerably the effectiveness of other organic catalysts such as hexamethylenetetramine and thiocarbanilide (see Figs. 11 and 12). As the latter by itself is practically inert, we have the interesting case of a mixture of two inactive substances exerting a distinct accelerating effect. In other cases we have found two vulcanisation catalysts to be "incompatible" in the sense that the effectiveness of the more active catalyst is actually decreased by the presence of the other.

As has been intimated already, an acceptable general explanation is not possible as to the mode of action of vulcanisation catalysts. In addition to the theories already mentioned, others have also been proposed. An observation of considerable interest in this connection is that rubber in solution or wetted with benzene becomes vulcanised by successive treatment with sulphur dioxide and hydrogen sulphide at the ordinary temperature (Peachey, this J., 1918, 696a). This reaction appears to be very suggestive in connection with the action of vulcanisation catalysts. None of the three modifications, Sλ, Sμ, and Sσ present in liquid sulphur appears to be in possession of exceptional chemical activity towards rubber (see above), but there is evidently a possibility that there is capable of existence yet another form of sulphur of much greater vulcanising power. Such a view, needing considerable modification however, has already been tendered (Indian-rubber World, 1919, **59**, 75; 1919, **59**, 214), but the scope for investigation in this direction is enormous. Indeed, the evidence available as yet is insufficient even to exclude the possibility that vulcanisation accelerators may activate the rubber and not the sulphur.

We are pleased to acknowledge the valuable assistance of Mr. C. W. H. Hoare, B.Sc., in connection with the experimental work recorded above, and our indebtedness to the Dunlop Rubber Co., in particular to Mr. J. V. Worthington, Technical Superintendent and Director, for permission to publish this paper.

DEFENDANT'S EXHIBIT "SS"

Comparison of Diphenylguanidine and Triphenylguanidine Formula of The Weiss Patent

	#1 (1359)	#2 (1375)
Rubber	50	50
Zinc Oxide	45.5	45.5
Sulfur	3.5	3.5
D. P. G.	1	....
T. P. G.	....	8

Time of cure, 40 lbs. steam	Tensile, lbs. sq. in.	Elongation, per cent	Tensile, lbs. sq. in.	Elongation, per cent
10	2390	640	2245	660
20	3410	635	3010	660
30	3480	590	3180	640
40	3470	570	3479	645
50	2460	470	3350	610

Test made Oct 5, 1925

E. W. Fuller.

Oct 13, 1925.

DEFENDANT'S EXHIBIT "UU"

UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK

In Equity. No. —

DOVAN CHEMICAL CORPORATION, Plaintiff,

vs.

NATIONAL ANILINE & CHEMICAL CO., INC., Defendant

On Patent No. 1,411,231, to M. L. Weiss

Reply Affidavit of Monroe H. Daniels

STATE OF NEW YORK,
County of New York, ss:

Monroe H. Daniels, being sworn, deposes and says as follows:

I am of mature age and reside at 305 Sheridan Avenue, Newcastle, Pa. I am at present Production Superintendent of the Newcastle plant of the Seiberling Rubber Company.

I am the Monroe H. Daniels who executed an affidavit on or about February 25, 1922 in connection with the application for a patent of Morris L. Weiss, serial number 514727, filed November 12, 1921, for vulcanization accelerators.

From May, 1913, until about the middle of March, 1920, I was employed as an analytical chemist by the Republic Rubber Company at Youngstown, Ohio, and during the years 1917, 1918, 1919 and 1920 I was employed as Chief Chemist of said Republic Rubber Company. On or about October 18, 1917, I personally employed Morris L. Weiss as an analytical chemist for said Republic Rubber Company which employment continued until about the 15th of March, 1920. On or about October 7, 1918, I employed Corl H. Eaton as an analytical chemist for the Republic Rubber Company, and said Eaton remained with said company after my leaving them. Shortly after Weiss' employment with the Republic Rubber Company he was placed in charge of the analytical work, and was permitted to investigate certain problems relating to the chemistry of rubber including the analysis and testing of accelerators for vulcanization, which latter work was carried on during his spare time from routine work.

At my request said Weiss visited Pittsburgh, Pennsylvania, during the first week in January, 1919, in order to look up data relating to the production of organic compounds which could be used as accelerators. We had previously been particularly interested in and desirous of producing tri-phenylguanidine which had been to some extent previously used experimentally as an accelerator by us. Said Weiss had told me prior to his trip to Pittsburgh, Pa., that he had been working on di-phenylguanidine as an accelerator and that he had found it to be more powerful than tri-phenylguanidine.

Upon said Weiss' return from Pittsburgh, Pa. I instructed him to devote as much time as possible on triphenlyguanidine as that substance was the one in which I was most interested at that time although I consented to further investigation of di-phenylguanidine as an accelerator.

During the years 1918 and 1919 record books of experiments and compounding tests on rubber were kept in the laboratory, and these were known as laboratory X books. One of these books containing numbers from 1700 up to 1800 or more was kept personally by me, and another X laboratory book containing numbers from 2000 up to 2187 was kept in the laboratory of which Mr. Weiss had charge.

I attach hereto photographic copies of one page of the laboratory X book kept by me, said page being numbered "1777" which contains an entry made by me early in the year 1919 in which entry I recorded a compound to be used as a splicing cement for red inner tubes for automobile tires. The 10⅝ parts of di-phenylguanidine shown on this page, number 1777, was obtained from a quantity of that substance previously produced by Morris L. Weiss, and was mixed in the compound with the other ingredients indicated by William Halliday who did the compounding work and operated the experimental mixing mill. This cement proved to be very satisfactory and I decided to use the same as a standard compound in production as soon as diphenylguanidine should be produced in commercial quantities.

The copy of the page above referred to is marked "Daniels' Exhibit A."

I also attach to this affidavit three photographic copies of pages numbered "2006", "2034" and "2042" of the laboratory X book kept in the laboratory of which said Weiss had charge at that time. I have personally compared these photographic copies with the corresponding pages in the original record book at the Republic Rubber Company which comparison was made yesterday, June 9, 1922. The sheet previously referred to as "Daniels Exhibit A" was also similarly compared by me with the original on the same date. All of the handwriting on said sheets numbered 2006, 2034 and 2042 I recognize as being that of Morris L. Weiss and to the best of my knowledge and belief said entries were made in the regular course of business on or about the dates stated thereon as indicated by the figures at the bottom of the various vertical columns. Said last-mentioned sheets are marked as "Daniels' Exhibit B."

I note at the bottom of sheet No. 2006 that the margin has not been included in the photograph, but this sheet corresponds to the photostat copy of the same attached to the affidavit of Corl H. Eaton executed June 3, 1922, which includes the words "Compare with X 2005 H" which existed on the original page and which I have added in ink on the photographic copy produced by me, said words and figures also having been in said Weiss' handwriting on the original sheet.

I have read the affidavits of Corl H. Eaton executed June 3, 1922 and of Carl H. Zieme executed June 3, 1922 in this cause. I believe that the statements made by said Corl H. Eaton are in many respects untrue and misleading for the following reasons:

When said Eaton was first employed in October, 1918, by the Republic Rubber Company as an analytical chemist, he handled practically all of the routine analytical work as an assistant to Morris L. Weiss, and his duties were distinctly routine and not experimental. If he at any time did any work with tri-phenylguanidine such work did not begin until after the middle of the year 1919, and I personally have no knowledge of his working to any extent whatever on either tri-phenylguanidine or di-phenylguanidine which knowledge would naturally have come to me in the regular course of his laboratory work if the same had been included therein, and such work if done by said Eaton would have been recorded in the laboratory X book. It is true that Mr. Zieme is a graduate chemist but at that time, in the latter part of 1918, his relations with the Republic Rubber Company were emphatically not chemical in any way, shape or form. He was manager of the hose departments. As such he had charge of production only, and while he had a good knowledge of compounding due to his having been previously compounding chemist for the hose departments, he was out of touch with laboratory development and work. As a matter of fact his duties kept him in the plant practically all day. The time he spent in the laboratory was very short and usually in consultation with me or the man who had charge of compounding for the hose departments. Said Zieme had never stated to me that said Eaton had disclosed to him any proposal to use di-phenyl-

guanidine as a rubber accelerator which would have been the natural thing for him to do owing to his general interest in the advancement of the work of the plant and in view of my position as chief chemist. In view of the short time elapsing between said Eaton's employment by the Republic Rubber Company and the alleged date of the disclosure by Eaton to Zieme, it is improbable that they became well enough acquainted with each other so that said Eaton would have disclosed any personal ideas he may have had to said Zieme.

I have examined the original copy of a report now in the possession of Morris L. Weiss and drawn up by him in March, 1920, and recognize this report as being identical with a copy which was given to me by said Weiss about the 1st of March, 1920, which copy was left in the files of the Republic Rubber Company. This report was prepared by Mr. Weiss at my request due to the fact that the preliminary experimental work had shown that di-phenylguanidine was worth while producing in commercial quanities for use in the factory and I decided to use that report as a basis for making di-phenylguanidine on a large scale. This report covers the work done by Mr. Weiss during the period from the early part of 1919 until the date that the report was submitted to me about March 1, 1920.

It is true as stated by said Eaton in his affidavit that I attended the meeting of the American Chemical Society early in September, 1919, and heard the paper prepared by Kratz, Flower and Coolidge relating to rubber accelerators, However, I have no recollection of having had any conversation whatever about said paper with said Eaton and could not have made the statement alleged by said Eaton because of the fact that I had full knowledge that said Weiss had previously done considerable work on di-phenylguanidine and was much interested in that substance as an accelerator.

I did, however, upon my return from Philadelphia immediately tell Mr. Weiss that the statements made in the paper read by said Kratz confirmed our experience with diphenylguanidine as an accelerator and that we should continue the work on the substance and develop a commercial process if possible.

Regarding the statement made by said Eaton that he actually used di-phenylguanidine as a rubber accelerator during the month of January, 1919, and at various times thereafter, I cannot see how it would have been possible for him to have done such work in the chemical laboratory or in the factory without my knowledge and consent. It could not have been done by said Eaton as a part of his regular duties as he was engaged entirely in routine analytical work during the period that he alleges to have used diphenylguanidine. I do not believe that it is true that said Eaton suggested to said Weiss that diphenylguanidine would be a better accelerator than triphenylguanidine because of my knowledge of Weiss' earlier work on accelerators, which began soon after said Weiss' employment by the Republic Rubber Company in October, 1917.

Monroe H. Daniels.

Subscribed and sworn to before me this 10th day of June, 1922. Joe C. Thomson, Notary Public, etc. (Seal.)

(Here follow Defendant's Exhibits QQ and QQ-1, marked Side folio pages 297, 297½, 298, and 299)

DEFENDANT'S EXHIBIT "WW"

STATE OF MARYLAND,
Allegany County, To wit:

Before me, a Notary Public of the above mentioned State and County, personally appeared Clinton A. Carlton, who being duly sworn, deposes and says:

I was employed in June, 1917, as a Research Chemist by the Republic Rubber Company at Youngstown, Ohio, and left their employ early in the year of 1918, probably in March, the exact date, I do not remember.

Morris L. Weiss came into the employ of the Republic Rubber Company several months prior to my leaving and worked directly under my supervision.

UNITED STATES PATENT OFFICE.

MORRIS L. WEISS, OF BROOKLYN, NEW YORK, ASSIGNOR TO DOVAN CHEMICAL CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

PROCESS OF MAKING DIPHENYLGUANIDINE.

1,422,506. Specification of Letters Patent. Patented July 11, 1922.

No Drawing. Application filed July 2, 1921. Serial No. 482,143.

To all whom it may concern:

Be it known that I, MORRIS L. WEISS, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Processes of Making Diphenylguanidine, of which the following is a full, clear, concise, and exact description.

Diphenylguanidine is indicated by the formula

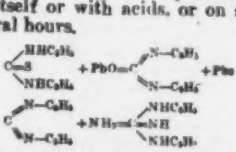
The object of my invention is the production of this substance in large or commercial quantities so that the same may be available in the chemical industries and particularly as an accelerator in the vulcanization of rubber compounds, as set forth in my co-pending application Serial No. 514,727, filed November 12, 1921, for vulcanization accelerators.

Prior to my invention it has not been possible to produce diphenylguanidine except in small quantities for use in chemical research and laboratory experiments. Even when produced for this purpose the product has been accompanied by the formation of comparatively large quantities of carbodiphenylimide, a thick treacle-like fluid, from which the diphenylguanidine is difficult to separate and which greatly reduces the yield of the latter.

Substituted guanidine was probably first synthetically produced in 1848 by A. W. Hoffman (Ann. Chem.-Parm 67,—129). Dry cyanogen chloride gas was passed into anhydrous aniline, from which he obtained the hydrochloride of a base which he termed "melaniline," at that time.

In 1869, Hoffman (Ber. 11,—460) synthesized diphenylguanidine by an entirely different method from that previously used. Thiocarbanilide was desulphurized with lead oxide in a solution of alcoholic ammonia. The resulting product had the same properties as that of his first product except that its melting point was 147° C. instead of 120°–130° C.

By Hoffman's last method, a large quantity of polymerized carbodiphenylimide is produced, due to the volatility of the ammonia, and so reduces the yield of diphenylguanidine that it is not possible to produce the chemical commercially. The very high volatility of the ammonia at the temperature of the reaction also results in a large loss. Schall has shown (Ber. 27,—2696) that carbodiphenylimide has a tendency to polymerize into three different isomeric forms. This may be accomplished by either digesting by itself or with acids, or on standing for several hours.



Carbodiphenylimide being very unstable, changes into isomeric forms before the combination with ammonia takes place. The longer the combination is delayed the more of the isomers are produced. The isomers do not combine with ammonia to form diphenylguanidine.

Weith (Ber. VII. 10—16) who first produced carbodiphenylimide or desulphurized diphenylthiourea

has shown that it combines with ammonia probably to form diphenylguanidine and that it is polymerized to form carbodiphenylimide. It also combines with water to form diphenylurea. By taking advantage of these suggestions and using an alcohol-water solution and by substituting an ammonium salt such as ammonium nitrate, sulphate, or chloride, which are not volatile at the reaction temperature 65°–70° C., I am enabled to minimize to a large extent the production of polymerized carbodiphenylimide, which otherwise forms due to the volatility of the ammonia, and thereby obtain a larger yield of diphenylguanidine.

I also found that the percentage of concentration of the alcohol and water solvent had an important effect on the reaction.

One form of the process, which I at present deem preferable, may therefore be described as follows:

Thiocarbanilide is first produced by any suitable method but I prefer to mix 65 parts by weight of carbon bisulphide with 1 part of sulphur, and 120 parts of aniline is then added. The mixture is then brought to a temperature of about 35°–40° C. and kept at

Defendant's Exhibit QQ (Sheet

that temperature for several hours after which it is allowed to cool. The semi-solid mass resulting is then spread out to allow an evaporation of the excess of carbon bisulphide and to dry the thiocarbanilide.

The solvent is then prepared by heating about 60 gallons of alcohol having a specific gravity of from .850 to .900 in a suitable kettle or tank and then adding 50 lbs. of ammonium nitrate and the thiocarbanilide above mentioned. The tank is closed by a cover and the temperature of the mixture is gradually raised to about 50° C. and stirred continuously by a mechanically operated stirring device. When said temperature is reached 200 lbs. of litharge are then added and the stirring continued for about one hour, during which time the temperature is gradually raised to about 75° C. At this point a test quantity is withdrawn and tested for thiocarbanilide and if not positive a few pounds more of litharge are added and the stirring continued for a short time or until the desulphurization is complete. The contents of the tank is then allowed to settle, the alcohol drawn off and removed from the lead sulphide by a suitable filter press or other means. The alcoholic solution is then distilled to a specific gravity of .950 and then mixed while hot with about 125 gallons of water and the solution boiled for about one hour. This causes all of the diphenylguanidine nitrate to dissolve, leaving the heavy treacle-like mass of polymerized carbodiphenylimide undissolved excepting a small portion of the latter which goes into solution and which may be removed by adding one or two pounds of "filter-cel," which is distomaceous earth in the form of a powder used for the purpose of filtering. The solution is then syphoned off and allowed to cool, after which a 25% solution of caustic soda is added, while stirring vigorously until the precipitation is complete. When completely settled the supernatant liquid is drawn off, the diphenylguanidine is filtered out, washed with water and dried.

I have discovered that the diphenylguanidine thus obtained may be further purified for use in particular processes by dissolving and recrystallizing in toluol. The difference in the degree of solubility of diphenylguanidine in hot toluol over that when cold is very marked. It has been found that toluol at its boiling point will dissolve to form a 50% solution of this substance while cold toluol will dissolve only to about 2 per cent.

I therefore dissolve the diphenylguanidine in the portion of about 2½ lbs. of the latter to a gallon of toluol which is thus raised to a temperature of about 105° C. in a closed container. The hot solution is then filtered and allowed to cool, settle and to stand until crystallization is complete.

The crystals are then filtered out and washed several times with fresh or pure toluol to remove the remaining traces of the impurities. About 70 lbs. of pure diphenylguanidine is thus obtained.

Having described this example of the invention, I do not wish to be understood as being limited to the exact proportions, ingredients, temperatures, and steps set forth, for various changes may be made without departing from the essential features of my invention. For example, other solvents than alcohol may be used, such as wood alcohol, pyridine, etc., and other ammonium salts may be employed instead of ammonium nitrate above mentioned.

What I claim and desire to protect by Letters Patent is:

1. The process of making diphenylguanidine which comprises, desulphurizing thiocarbanilide by the use of a metallic oxide in an alcoholic solution of an ammonium salt.

2. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of a lead oxide in an alcoholic solution of an ammonium salt.

3. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of a lead oxide in an alcoholic solution of ammonium nitrate.

4. The process of making diphenylguanidine which comprises desulphurizing thiocarbanilide by the use of litharge in an alcoholic solution of ammonium nitrate.

5. The process of making diphenylguanidine which comprises dissolving an ammonium salt and thiocarbanilide in an alcoholic solution, then adding a lead oxide and heating to 75° C. to desulphurise the thiocarbanilide, then dissolving the diphenylguanidine nitrate thus formed, then separating the remaining carbodiphenylimide from said solution by causing precipitation with an alkaline solution, and then washing and drying the precipitate.

6. The process of making diphenylguanidine which comprises dissolving ammonium nitrate in an alcoholic solution, then adding litharge and heating to 75° C. to desulphurize the thiocarbanilide, then dissolving the diphenylguanidine nitrate thus formed, by distillation to a specific gravity of .950 and by addition of hot water, and then separating the carbodiphenylimide from said solution by causing precipitation by the addition of caustic soda, and then washing and drying the precipitate.

7. In a process of making diphenylguanidine the steps which comprise adding an alkali to a solution thereof containing carbodiphenylimide to cause precipitation, and then washing and drying the precipitate.

8. In a process of making diphenylguanidine the steps which comprise adding caus-

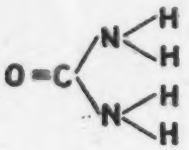
tic soda to a solution thereof containing carbodiphenylimide to cause precipitation, and then washing and drying the precipitate.

9. In a process of making diphenylguanidine containing as a reaction impurity carbodiphenylimide, the steps which comprise dissolving the same in hot toluol, cooling and then washing the crystals thus formed.

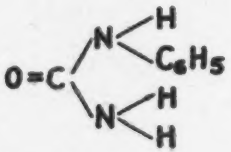
10. In a process of making diphenylguanidine containing as a reaction impurity carbodiphenylimide, the steps which comprise dissolving the same in hot toluol, cooling, and then washing the crystals thus formed with pure toluol, and then drying.

Signed June 28th, 1921.

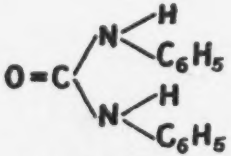
MORRIS L. WEISS



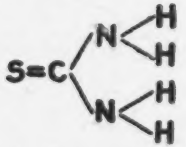
Urea



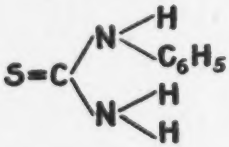
Monophenylurea



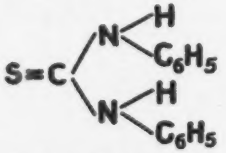
Diphenylurea



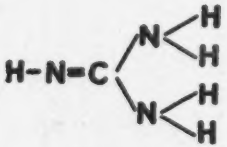
Thiourea



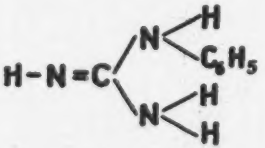
Monophenylthiourea



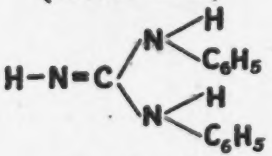
Diphenylthiourea
(Thiocarbanilide)



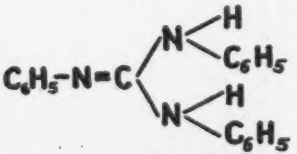
Guanidine



Monophenylguanidine



Diphenylguanidine



Triphenylguanidine

C Represents Carbon
H Represents Hydrogen
S Represents Sulphur
N Represents Nitrogen
O Represents Oxygen
C_6H_5 Represents Phenyl group

— (Lines) Represents "Valences" or bonds between atoms

Defendant's Exhibit QQ-1

When Morris L. Weiss came into the employ of the Republic Rubber Company I was doing research work on the guanidines and had developed triphenylguanidine.

When preparing to leave the employ of the Republic Rubber company I directed and advised the said Morris L. Weiss to proceed with research work on the phenylated guanidine derivatives, including monophenylguanidine and diphenylguanidine as well as the guanidine bases.

To the best of my knowledge and belief said Morris L. Weiss had had no knowledge or experience in accelerators for rubber prior to being employed by the Republic Rubber Company.

Clinton A. Carlton.

Subscribed and sworn to before me, this 3rd day of June, 1922. Pearl Piper, Notary Public. (Seal.)

Witness: H. H. Replogle.

The following depositions were stipulated from the case of Dovan vs. National Aniline and Chemical Co., Inc. (Stipulation, Rec., 577.)

SETH R. CLARK, called as a witness on behalf of the defendant, being first duly sworn, testifies as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. Mr. Clark, in whose employ are you now?
A. I am with the Fisk Rubber Company.
Q. 2. In what capacity?
A. In the development department.
Q. 3. Have you an official title, and if so, what is it?
A. I have not.
Q. 4. Were you ever in the employ of the Republic Rubber Company?
A. I was for fifteen years.
Q. 5. When did that employment end?
A. In November 20th, 1920.
Q. 6. During 1919 who was in charge of the chemical laboratory of the Republic Company?
A. Mr. M. H. Daniels.

Q. 7. Was he under you?

A. He was.

Q. 8. And what was your official title?

A. My official title was assistant mill superintendent in charge of development work.

Q. 9. Did you know whether or not Morris L. Weiss was employed in the laboratory?

A. He was employed in the laboratory.

Q. 10. And was he under Mr. Daniels?

A. He was.

Q. 11. Can you state what work was being done throughout the first nine months of the year 1919 on rubber accelerators in the laboratory of the Republic Rubber Company?

A. Not definitely. We were carrying on continually work on accelerators.

Q. 12. Can you state what accelerators were being worked upon to a greater extent than others?

A. Yes, we had already constructed a house some few years before—a chemical department in which we made practically all of our thiocarbanilide, and had also constructed another chemical department in which we made triphenylguanidine, and at the end of that period, as I remember it, we had probably produced up to three hundred pounds of triphenylguanidine.

Q. 13. That is up to September, 1919?

A. Around in that date. I might explain that this way: I know that when Mr. Daniels left the employ of the Republic Rubber Company there were about two hundred pounds of triphenylguanidine on hand, as I remember it, that we had made in the laboratory.

Q. 14. And had made when?

A. During the latter part of 1918.

Q. 15. Did the work on triphenylguanidine continue through the first nine months of 1919?

A. It did.

Q. 16. Did that work practically come to an end at any time in 1919?

A. It came to an end in 1919 along towards the end of the year.

Q. 17. Will you state what the circumstances were in that connection as fully as you can?

A. I can. The company was more or less conservative in regard to the members of the company attending meetings and one thing and another like that, and I distinctly remember that to the meeting in Philadelphia Mr. Daniels went. On his return from that meeting, he partially, I suppose, for the purpose of justifying the trip, came to Mr. Brown and myself in our office and told us that the company was perfectly justified in sending him on the Philadelphia trip; that he had found out a lot about accelerators down there, and we asked him whether he had the dope and he said he did, and that he was immediately going to start work and——

By Mr. Cooper: I think this is all hearsay, if your Honor please.

By Mr. Edmonds: I think the witness should be allowed to finish first and the objection made afterwards.

By the Court: I think the objection is good.

By the Court:

Q. 18. Tell us what you did after you came back?

By Mr. Edmonds:

Q. 19. Will you continue only with respect to things that were said in your presence within your hearing?

By Mr. Cooper: That is all hearsay.

By the Court: What he did.

Q. 20. Then will you continue with your narrative only with respect to what you did, what Daniels did, what was done by the Republic Company?

A. We stopped work on triphenylguanidine and started experimental work on diphenylguanidine.

Q. 21. When was that?

A. In the latter part of 1919, immediately after Daniel's return from the Philadelphia meeting.

Cross-examination.

By Mr. Cooper:

X Q. 22. Who did the work?

A. The work was done under Mr. Daniel's supervision.

X Q. 23. By whom?

A. I have no idea.

X Q. 24. I did not understand what your connection with the Fisk Rubber Company is?

A. I am in the development department.

By the Court:

Q. 25. Is Mr. Weiss in that department under Daniels?

A. At the Republic Rubber Company?

Q. 26. Yes.

A. Oh, yes, in the chemical laboratory upstairs.

By Mr. Cooper:

X Q. 27. Daniels was downstairs and Weiss was upstairs?

A. Correct. We had the physical test laboratory downstairs and the chemical research laboratory upstairs.

X Q. 28. Do you not know that Mr. Weiss did work on D. P. G.?

A. I knew Weiss did some work in the laboratories, yes. I might explain my opinion of that work if you——

X Q. 29. No, I am not asking you for your opinion of the work.

A. The reason I say that is——

X Q. 30. When did Daniels leave the Republic Rubber Company?

A. I would say it was in March, 1920. It was when Mr. Jones came with the company as president; soon after that.

X Q. 31. Did you have anything to do while you were with the rubber company, with the keeping of laboratory records?

A. The laboratory records? Very little, as a laboratory compound was given to try out in the plant a whole lot.

X Q. 32. Are you a chemist yourself?

A. I am a graduate chemist.

X Q. 33. Whereabouts was your office at the Republic Rubber —?

A. My office was up on the second floor—at the period in question and for the last three or four years that I was with them my office was in the second floor of the five story building.

X Q. 34. The same building that has the chemical laboratories in them?

A. No, no, entirely apart from that.

X Q. 35. I suppose the plant was an extensive one?

A. Medium sized.

X Q. 36. Employing about how many hands during this period?

A. I should judge about 1,500 or 2,000.

X Q. 37. And how many buildings?

A. In the neighborhood of a dozen counting everything.

X Q. 38. And how far away was your five story building from the place where the laboratory was?

A. A couple of hundred feet.

X Q. 39. How often would you be in that laboratory building? Every day?

A. No, sir, not every day.

X Q. 40. Every week?

A. Yes, I would be there at least once a week.

X Q. 41. And was it your business to follow up the detail of what was done there, or just to talk to Mr. Daniels?

A. It was not.

X Q. 42. Mr. Daniels was the one who reported to you?

A. Yes, sir.

X Q. 43. You knew there were laboratory records kept there, did you not?

A. Absolutely. I put them into the factory.

X Q. 44. And do you know about this ex-laboratory book?

A. I know of ex-books that were used, yes, sir.

X Q. 45. Do you know something about some of the leaves being abstracted from one of those books?

A. Absolutely not.

X Q. 46. They were supposed to be all intact and kept as permanent records of the company?

A. Yes, sir.

X Q. 47. Was it after the receivership that you left?

A. No, sir.

X Q. 48. You left before the receivership?

A. Yes, sir, about five months.

SUR-REBUTTAL PROOFS

SETH R. CLARK, recalled as a witness on behalf of the defendant in sur-rebuttal, being previously sworn, testifies as follows:

Direct examination.

By Mr. Barrows:

Q. 49. Was there any general rule at the Republic Company regarding the entering of compounds in these laboratory X-books?

A. There always was a general rule.

By Mr. Cooper: Wait; I do not see that that is any rebuttal of anything.

By the Court: I will take it. What is the next question?

Q. 50. What were the instructions regarding the making of entries in these laboratory X-books?

By Mr. Cooper: I do not see how that enters into the matter.

By the Court: What is the purpose of this?

By Mr. Barrows: Mr. Weiss has said he made certain experiments and he did not put them in his laboratory notebook. I want to bring out that the instructions there were that all compounds should be put in the notebook.

By the Court: Say that, if it is so.

A. We had an absolute rule that the minute a man wrote out his compound on a rough piece of paper he should copy it in the book with the date, and in the first column of the experimental stock under which he was working, after he had labelled the page to indicate why the experiments were carried on.

Q. 51. And was there any general custom or rule regarding the placing of the dates on the notebook?

A. The rule was that the date was supposed to be put on when the man first made out his recipe. He sent his rough draft of the compound downstairs to the man who did the mixing. Then he had the copy in his book, so that if the man downstairs who did the mixing lost the recipes or anything, he would have his original records copied over into his book.

Q. 52. So that these laboratory X-books should contain all of the compounding tests which the man in charge carried out?

A. They absolutely should.

Cross-examination.

By Mr. Cooper:

X Q. 53. Well, do they? To your knowledge do they contain all the compounds that every expert connected with your company ever got up?

A. The testimony of your witness shows that they——

By Mr. Cooper: I move to strike that out.

By the Court: Strike it out.

X Q. 54. Do they contain it?

A. They should contain it.

X Q. 55. Do they?

A. I do not know.

JAMES W. KINSMAN, called as a witness on behalf of the defendant, being first duly sworn, testifies as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. Mr. Kinsman, by what company are you employed at present?

A. I am employed by the E. I. Dupont de Nemours Company of Delaware.

Q. 2. Will you state your official capacity with that company?

A. I am now salesmanager in charge of the sales of dye stuffs, intermediates, organic chemicals, rubber vulcanizing accelerators, activating agents, and others of that group.

Q. 3. Did you ever hear of a paper read by Dr. Kratz and two of his associates at a meeting of the Chemical Society in September of 1919?

A. Yes, sir.

Q. 4. Will you state when and under what circumstances you became familiar with that paper?

A. I recall that early in June of 1920 Mr. Kratz who was associated and still is, I believe, with the Falls Rubber Company of Cuyahoga Falls, sent the Dupont Company an inquiry for various organic chemicals with which I assumed he wanted to experiment with to determine their properties as rubber vulcanizing accelerators.

I replied to Mr. Kratz and sent him as many of the articles as we had available and at the same time said that I recalled his giving an address before the New Jersey Chemical Society and asked if it was possible for him to give me a reprint of that article. Mr. Kratz replied promptly and sent two papers one of which was his address before the New Jersey Chemical Society and the other was his address before the American Chemical Society in Philadelphia in September, 1919.

Q. 5. Did you read that paper on receiving it, and if so, will you please state what it meant to you with respect to rubber vulcanizing?

By Mr. Cooper: It seems to me that is incompetent, what it meant to the salesmanager of organic chemical sales for Dupont.

Q. 6. What did you learn from your reading of that paper?

By Mr. Cooper: I do not think that is a competent question.

By the Court: I do not, either.

Q. 7. Will you state what you found in the paper with respect to the accelerating power of rubber accelerators?

By Mr. Cooper: Is that not calling for secondary evidence?

By the Court: Yes, it is secondary evidence. He can tell what he did afterwards.

By Mr. Edmonds: I am trying to avoid what we agreed should be kept out, this commercial exploitation by any of these companies.

By the Court: Where is the paper?

By Mr. Edmonds: It is the same Kratz paper we have been discussing. I have no objection to his telling the whole story of the Dupont entrance into this business but

I was trying to avoid that because of our agreement at the opening of this trial.

By the Court: I do not think you can ask him for the contents of the paper.

Q. 8. Did your company, the Dupont Company, enter upon the manufacture and sale of diphenylguanidine? Please answer yes or no.

A. Yes, sir.

Q. 9. Did it do that at a time subsequent to your receipt of this paper and prior to March 28th, 1922?

A. Yes, sir.

Q. 10. Has the company continued to manufacture and sell diphenylguan-dine since March 28th, 1922?

A. It has.

Cross-examination.

By Mr. Cooper:

X Q. 11. Just what was the date when the Dupont organization with which you are connected first put diphenylguanidine in the market?

A. I believe that the first sale we made was during the latter part of October, 1921, about the 26th or 27th.

X Q. 12. That was after the Dovan Chemical Company was on the market with the same product that you went into competition with them; is that not correct?

A. The only product I found that the Dovan Chemical Company had was a reduced form of what we determined in our laboratory to be diphenylguanidine. We put out a pure diphenylguanidine, which is what the trade asked us for.

X Q. 13. You got the Dovan Company's XLO product and analyzed it to find out what the substance was and then put that substance on the market; is that not correct?

A. No, sir.

X Q. 14. Go ahead and state what the fact was. You got a sample of this product of the Dovan Chemical Company and analyzed it.

A. We were interested in manufacturing diphenylguanidine because of inquiries from the trade.

By Mr. Cooper: I move to strike that out.
By the Court: Strike it out.

X Q. 15. I am asking you this. Did you get a sample of the XLO product of the Dovan Chemical Company?
A. Yes, sir.
X Q. 16. Did you have that analyzed?
A. Yes, sir.
X Q. 17. And by that analysis you determined the active properties of the XLO due to the diphenylguanidine in it, is that correct?
A. We found diphenylguanidine, but at that time we were not in position as rubber chemists to determine what was the activating agent.
X Q. 18. But you found diphenylguanidine?
A. Yes.
X Q. 19. And you found a demand for diphenylguanidine and then you proceeded to make it and sell it?
A. We found a demand for diphenylguanidine before we received the accelerator XLO.
X Q. 20. Then you found out what was in it and then went on the market yourselves. That is correct is it not? Yes or no.
A. We knew of the demand for diphenylguanidine before we got the samples of XLO.
X Q. 21. After you got the sample of XLO and analyzed it, then you went into the market yourselves.
A. Not as a result of receiving the sample.

By the Court:

Q. 22. Did you, yes or no?
A. We did.

Dedirect examination.

By Mr. Edmonds:

R. D. Q. 23. Was this all after you had received the copy of the Kratz paper?
A. Yes, sir.

ALFRED L. LOEBENBERG, called as a witness on behalf of the defendant, being first duly sworn, testifies as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. Will you give your present employer and your official title?

A. I am production manager of the National Aniline & Chemical Company.

Q. 2. Have you ever met Morris L. Weiss, the patentee of the patent in suit here?

A. I have.

Q. 3. Will you say when?

A. I met him when he applied to us for a position.

Q. 4. For a position with the National Aniline, the defendant here?

A. That is right.

Q. 5. On that occasion was anything put in writing in connection with his application?

A. There was.

Q. 6. State generally what it was?

A. The formal application blank of the National Aniline.

Q. 7. Look at that document, please, and say what it is?

A. That is the application form.

Q. 8. Do you know whose handwriting is there?

A. Mr. Weiss's handwriting.

Q. 9. Did you see him write that?

A. Yes.

Q. 10. Whose handwriting appears on the back of that sheet?

A. My own.

Q. 11. Can you state anything about your conversation with Weiss at the time this application was made outside of the usual data filed in in the blanks on the front of this application?

A. Mr. Weiss in applying to us for a position qualified himself as a man experienced in rubber chemistry; stated that he had done some research, that is, development work in the manufacture and application of certain rubber accelerators. At the time I noticed the accelerators to

which he specifically referred. The accelerators included aniline, thiocarbanilide, triphenylguanidine, diphenylguanidine, nitroso dimethyl aniline.

Q. 12. That I take it is the part referred to at the top of this sheet?

A. That is correct.

Q. 13. What is referred to lower down on the sheet?

A. In the course of our conversation Mr. Weiss, discussing rubber accelerators in general, stated that he had developed a process for the manufacture of diphenylguanidine and he wanted to interest us in that process, that is, with a view toward manufacturing it commercially. The process, he said, had been developed by him.

In the course of that conversation he referred to diphenylguanidine as an accelerator which apparently was known in that he referred to some ratios of value of diphenylguanidine and other accelerators, and I made a notation at that time of a reference to Dr. Kratz, who as I remember had made reference to the relative values of various accelerators including according to this notation, aniline, thiocarbanilide, diphenylguanidine, triphenylguanidine and hexamethylin tetramine. The conversation with Mr. Weiss revolved to a certain extent on the question of interesting us in this process.

By Mr. Cooper: I will object to that. Let the witness say what he said.

By the Court: Yes, strike it out.

(A. to Q. 13 continued.) Mr. Weiss, in qualifying himself for this position which he was seeking with us, attempted to introduce——

By the Court:

Q. 14. What did he say? Tell us what he said.

A. He stated that diphenylguanidine was a very valuable accelerator in that it offered certain advantages over other accelerators which had been used, and he inquired whether we would be interest- in developing that particular process as a commercial proposition.

By Mr. Edmonds:

Q. 15. Reference was made to Dr. Kratz?

A. A reference was made to Dr. Kratz.

Q. 16. Does Dr. Kratz's name appear written on the back of that sheet?

A. It does.

Q. 17. And who wrote it there?

A. I wrote it.

Q. 18. At that time?

A. At that time.

Q. 19. Was there any discussion as to who had originated the use of diphenylguanidine as an accelerator?

A. There was not.

By Mr. Edmonds: I offer in evidence the application identified by the witness's testimony.

(Marked Defendant's Exhibit M, attached to affidavit of Loebenberg file.)

Cross-examination.

By Mr. Cooper:

X Q. 20. How many candidates for a technical position have you seen in the last two or three years?

A. Oh, possibly fifty to one hundred, I should say.

X Q. 21. This pencil writing on the blank side of this form that you say Dr. Weiss filled out, is in your handwriting?

A. My handwriting.

X Q. 22. All of it?

A. Every bit.

X Q. 23. Including the arrow and the "Dr. Kratz"?

A. That is right.

Robert L. Moore, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. What is your full name?

A. Robert L. Moore.

Q. 2. Your age?

A. Twenty-seven.

Q. 3. Where do you live?
A. Pittsburgh, Pennsylvania.
Q. 4. What is your occupation?
A. Chemist.
Q. 5. Were you ever employed by the Falls Rubber Company?
A. Yes, sir.
Q. 6. When?
A. In 1917.
Q. 7. What time in 1917 did you go there?
A. In May.
Q. 8. And how long did you stay?
A: I left there the latter part of September, the same year.
Q. 9. What were your duties?
A. I was was an assistant to Mr. Kratz.
Q. 10. Do you recall a batch of one thousand gray tubes that were made while you were employed there?
A. I do.

By Mr. Cooper: I think that is rather a blunt way of putting a proposition that may be of the utmost importance to the outcome of the case.
By the Court: Do you object?
My Mr. Cooper: I do.
By the Court: Objection overruled.

Q. 11. I show you a paper marked Defendant's Exhibit K for identification and ask you if you can tell what this sheet is?

By the Court:

Q. 12. Is that in your handwriting?
A. Yes, sir.
A. (to Q. 11) This is a test sheet which I made in August, 1917, at the Falls Rubber Company laboratory.

By Mr. Barrows:

Q. 13. Do you know what the compound was that was used in this test other than that it was marked "T-63"?
A. Why, it was a gray inner tube stock T-63 that we were experimenting with at that time.

By Mr. Barrows: I would like to offer this sheet in evidence.

(Defendant's Exhibit K, for identification, marked in evidence.)

Cross-examination.

By Mr. Cooper:

X Q. 14. The fourth column on the left headed "Dimensions of Test Piece—Thickness—Width"—are those figures expressed in inches?

A. Yes, 64th of an inch.

X Q. 15. The thickness is 9/64ths?

A. Yes, sir.

X Q. 16. That was a gray inner tube, was it?

A. No, it was not. It was a sample of a stock which was going into inner tubes. It was a slab procured for test purposes.

X Q. 17. These you had were 9/64ths of an inch thick, 13/64ths wide?

A. Yes, the test piece was dyed out 13/64ths wide.

X Q. 18. You do not know the length?

A. The length of the test piece?

X Q. 19. Yes, the larger tubular dimensions?

A. Standard length test piece.

X Q. 20. Square?

A. No, it is what we call a dumbell shape. The ends are large and then it is constricted down to about a quarter of an inch width in the middle, where the break actually occurs. That is standard practice on this machine.

X Q. 21. Its original length was 12.5 inches, or whatever the figure is?

A. That is in percentages. That is not in inches. That is the permanent set for the amount that the test piece gained by the stretching during the machine testing.

X Q. 22. What are these tests supposed to be good for?

A. They evaluate the quality of the stock, give us a definite idea in comparing this stock with another stock in experimental work in the laboratory.

X Q. 23. Is this what you would denominate a low grade or a high grade mixture?

A. It was a low-priced stock at that time.

X Q. 24. By low-priced, you mean low grade?

A. No, not necessarily. The stock was of average quality.

X Q. 25. That is, average quality in comparison with other products?

A. For that type of stock, yes.

X Q. 26. Was it average quality for the Falls Rubber Company's production at that time?

A. No, I would not say that. I do not believe it was.

HENRY V. MORSE, called as a witness on behalf of the defendant, being first duly sworn, testifies as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. You are employed by what company?

A. Atlantic Dye Stuff Company.

Q. 2. What is your position with that company?

A. I have charge of the accelerator department.

Q. 3. Will you state whether or not you attended the Philadelphia meeting in September, 1919, when the Kratz paper on rubber accelerators was read?

A. I did.

Q. 4. Prior to that time had you been engaged in work on rubber accelerators?

A. I had.

Q. 5. Prior to March 28th, 1922, did your company put diphenylguanidine on the market?

A. I cannot recall.

Q. 6. Can you state whether or not your company had made preparations for doing so prior to that date?

A. We had been making preparations.

Q. 7. Has your company put that product on the market?

A. It has.

Q. 8. And from the time it started to the present time, has it kept on the market continuously?

A. It has.

Cross-examination.

By Mr. Cooper:

X Q. 9. At the time that you were preparing or that your company was preparing to put diphenylguanidine on the market, you knew of the Dovan Chemical Company and its product?

A. I did not.

X Q. 10. Never had heard of it?

A. No, sir.

X Q. 11. Did you know that the Dupont concern had diphenylguanidine on the market?

A. I did not.

X Q. 12. You did not know that any other concern had?

A. Not at the time we were preparing about it.

X Q. 13. Did you know the States Metals Company?

A. Yes, sir.

X Q. 14. Did you know what if was putting out?

A. I know it was putting out a compound called XLO.

X Q. 15. Did you get a sample of that?

A. I did.

X Q. 16. You do not know anything about what was in that sample?

A. I knew what was in it.

X Q 17. What?

A. Diphenylguanidine and magnesia.

By Mr. Cooper: Before I forget it, you will not dispute my statement appearing in the injunction motion papers that the States Metals Company was the selling agent of the Dovan Chemical Company?

By Mr. Edmonds: No.

William F. Russell, called as a witness on behalf of the Defendant, being called first duly sworn, testifies as follows:

Direct examination.

By Mr. Barrows:

Q. 1. What is your full name?

A. William F. Russell.

Q. 2. Your age?
A. Thirty-five.
Q. 3. Where do you reside?
A. Norwalk, Connecticut.
Q. 4. What is your occupation?
A. Chemist.
Q. 5. Where are you employed?
A. Norwalk Tire & Rubber Company.
Q. 6. And what is your position there?
A. Chief Chemist.
Q. 7. How long have you been Chief Chemist?
A. Since 1914.
Q. 8. At the Norwalk Tire & Rubber Company?
A. Yes, sir.
Q. 9. Do you know George D. Kratz?
A. Yes, sir.
Q. 10. And was he ever employed by the Norwalk Tire & Rubber Company?
A. Yes.
Q. 11. Were you acquainted with the work which Mr. Kratz was doing in the latter part of the year 1916?
A. Yes, sir.
Q. 12. What was your relation to him at that time?
A. Mr. Kratz was my chief assistant.
Q. 13. And were you familiar with the work he was doing?
A. Absolutely.
Q. 14. I hand you Defendant's Exhibit E and ask you if you can tell what these are and where they were obtained from?
A. These are records of certain work which Mr. Kratz did at that time and which were left in the report book of his work in general, placed in the files of the laboratory.
Q. 15. And these were produced from the files of the Norwalk Tire & Rubber Company?
A. Yes, they were taken from those files.
Q. 16. By you?
A. Yes, sir.
Q. 17. Do you recognize the handwriting on these sheets?

By Mr. Cooper: I object to that. The other man identified it as his handwriting. I do not question that.

Q. 18. Do you know that the work described on these sheets was done by Mr. Kratz in the year 1916?

A. Yes, sir.

Q. 19. Were you familiar with the work he was doing at that time?

A. Absolutely.

Q. 20. How closely in touch were you with this work?

A. We had conversations on it practically every day.

Q. 21. What was your relation to him at that time officially?

A. Officially I suppose I was his superior officer.

Q. 22. And you knew of the results which he obtained and which are described on these sheets?

A. Yes, I knew of them.

Q. 23. Do those records show that diphenylguanidine is an accelerator for the vulcanization of rubber?

By Mr. Cooper: I object to that.

By the Court: Objection sustained.

Q. 24. Do you know why Mr. Kratz used the particular mixtures he did to carry on these experiments?

By Mr. Cooper: I object to that.

By the Court: Objection sustained.

Q. 25. Do you know how many tests Mr. Kratz made on diphenylguanidine prior to the reports of the work described in these reports?

A. I cannot remember exactly. Do you mean on diphenylguanidine alone?

Q. 26. Yes.

A. I should say probably he did anywhere from eight to ten or perhaps twelve experiments.

Q. 27. Do you know what tests Mr. Kratz made on the vulcanized samples that he produced using diphenylguanidine as an accelerator?

A. I did not get that.

Q. 28. Do you know what tests he made of the vulcanized products, the vulcanized rubber made with diphenlyguanidine?

A. Physical tests?

Q. 29. Yes.

A. Yes.

Q. 30. What were these tests?

A. We used the ordinary thumb and tooth test as it is called, which rubber chemists are in the habit of using for estimating the quality of their stocks.

Q. 31. And you still use those tests?

A. We still use those tests.

Q. 32. You were subpœnaed by the plaintiff, the Dovan Chemical Corporation, to be in attendance, were you not?

By Mr. Cooper: I object to that.

By the Court: What difference does it make. He is here to tell the truth.

A. I was.

Cross-examination.

By Mr. Cooper:

X Q. 33. Is the thumb and tooth test the only one used in your company, Doctor, to test a new sample or degree of rubber?

A. No, sir.

X Q. 34. What else?

A. We have another method of testing when we want to express our result in figures, the machine method of testing.

X Q. 35. Do you regard that as satisfactory when you are trying to arrive at a determination whether to use a new mix or not?

A. No, sir.

X Q. 36. With a thumb and tooth test and a machine test, do you determine by the result of those alone whether you will put a new experimental mix into production?

A. I would determine by the thumb and tooth test alone whether I would put a new compound into use in the factory.

X Q. 37. After those tests to which you have referred of Mr. Kratz's sample, did you put the diphenylguanidine mixed into commercial production in the factory?

A. We did not.

X Q. 38. When if ever did your company first begin to use diphenylguanidine in commercial production?

A. We never used diphenylguanidine in commercial quantities.

X Q. 39. You have always used some other accelerator if you used an accelerator at all?

A. We have.

Redirect examination.

By Mr. Barrows:

R. D. Q. 40. Why is it that you have not used diphenylguanidine commercially at Norwalk?

By Mr. Cooper: I object to that. I think it is incompetent.

By the Court: I will take it. Objection overruled.

A. We never used it commercially on account of the fact that we saw no advantage in displacing the accelerators we were then using by diphenylguanidine.

NORMAN A. SHEPARD, called as a witness on behalf of the defendant, being duly sworn, testifies as follows:

Direct examination.

By Mr. Edmonds:

Q. 1. Give the name of your present employer?

A. Firestone Tire & Rubber Company.

Q. 2. How long have you been in the employ of that company?

A. Since April, 1919.

Q. 3. And what is your capacity there now?

A. I am in the research laboratory, Director of Organic Research.

Q. 4. Did you attend the meeting of the Rubber Section of the Chemical Society in Philadelphia in September, 1919?

A. I did.

Q. 5. You heard the Kratz paper which we have discussed here read?

A. I did.

Q. 6. Will you state whether or not any of the tables included in the paper were displayed at the time the paper was read?

By Mr. Cooper: I will object to that. I do not see what difference it makes whether the tables were displayed or not. The paper was read, Kratz said it was, and we have not any disposition on our part to contradict Kratz.

By the Court: I will take it.

A. Certain tables were put on the blackboard.

Q. 7. Did you take copies of them?

A. I made some notes of these tables.

Q. 8. Do you know whether that was done by others around you?

By Mr. Cooper: I will object to this, if your Honor please.

By the Court: If he knows of his own knowledge, he may state.

Q. 9. Do you know of your own knowledge whether others in the audience took copies of that table?

A. I believe they did.

Q. 10. Did you receive a copy of the paper in print later on?

A. Reprint, you mean?

Q. 11. Reprint, or in the magazine which was published?

A. I read it in my personal copy of the magazine.

Q. 12. Were you familiar generally with the literature of accelerators at that time?

A. I was.

Q. 13. Will you state whether or not any publication had come to your attention up to that time including such figures as were given in the table included in the Kratz paper?

By Mr. Cooper: I will object to that as incompetent.

By the Court: He say state what it meant to him.

Q. 14. Will you state in your own way just what the Kratz paper meant to you as a rubber chemist?

A. This paper was the first paper which gave us any definite idea of the relative activity of accelerators and as such was an extremely important paper, because having these relative activities we were enabled to apply the various accelerators sensibly.

Q. 15. Along in the following year 1920 did you meet Mr. Weiss?

A. I did.

Q. 16. About March 3rd, 1920?

A. I believe that was the date; early in March.

Q. 17. Had you met him before that time?

A. I had not.

Q. 18. Will you state what occurred on March 3rd, so far as concerns yourself and Mr. Weiss?

By Mr. Cooper: Where was this meeting?

Q. 19. Will you start off by saying where the meeting occurred?

A. In the lobby of the Firestone Tire & Rubber Company.

Q. 20. And what was the occasion for the meeting?

A. Mr. Weiss applied for a position in our Research Laboratories.

Q. 21. Were you in need of further assistants in the research laboratory at that time?

A. We were.

Q. 22. When this application was made were you instructed to see him?

A. I was.

Q. 23. By whom?

A. By the chief chemist.

Q. 24. And did you see him?

A. I did.

Q. 25. Where did you see him?

A. I saw him in the lobby of the Firestone Tire & Rubber Company.

Q. 26. And did your conversation from that time on take place in the lobby?

A. In the lobby of the Firestone Company.

Q. 27. Did you ask Mr. Weiss what qualifications or experience he had that would warrant you in giving him a position?

By Mr. Cooper: Let him state the conversation or what the substance of the conversation was.

By the Court:

Q. 28. What did you say?

A. He gave me first his training—Brooklyn Polytech, Columbia University; presented at least one reprint of previous work; then he stated that he had worked out a method for the preparation of an important accelerator, and showed me the typewritten copy of his work, which was a report of the Republic Rubber Company. This was his chief argument—or he considered it his chief asset in seeking a posi-

tion with the Firestone Company. He made no mention of having discovered this material as an accelerator. In fact, he ascribed the discovery to Mr. Kratz.

By Mr. Cooper: I will object to that last. I think the witness should say what he said.

By the Court: Yes, strike it out.

Q. 29. Just tell us exactly what he said.

By Mr. Edmonds:

Q. 30. Will you state as a matter of fact, whether or not in the course of your conversation with Mr. Weiss he made any claim to have originated the idea of using diphenylguanidine as an accelerator?

A. He did not.

Q. 31. In the course of that conversation was anything put in writing?

A. The usual application was filled out.

Q. 32. Is the paper I hand you the application referred to?

A. That is the application.

Q. 33. In whose handwriting is it?

A. Mr. Weiss's handwriting.

Q. 34. How do you know that that is Mr. Weiss's handwriting?

A. Why, it is my recollection that he filled that out in my presence.

Q. 35. Do you recall whether or not you saw him write the matter appearing on the first page?

A. I do not recall whether I left Mr. Weiss in the lobby at the table writing this application.

Q. 36. If you left him, did you see him further after leaving him?

A. I did.

Q. 37. At that same time while he was there at the Firestone Company on that visit?

A. I must have, because this application was handed to me.

Q. 38. Have you read the matter appearing on the first page?

A. I have.

Q. 39. Was that matter the subject of conversation between you and Mr. Weiss?

A. It was.

Q. 40. At that time when that application was made out?

A. Yes.

Q. 41. Can you recall anything further about your conversation with Mr. Weiss on the subject of the Kratz paper or anything done by Mr. Kratz additional to what is on that paper?

A. I do not recall any further conversation.

By Mr. Edmonds: The application referred to by the witness is offered in evidence in behalf of the defendant.

(Marked Defendant's Exhibit L.)

Cross-examination.

By Mr. Cooper:

X Q. 42. You mentioned on your direct examination that when Mr. Weiss came for a job, he showed you what you described as a typewritten report that he, Weiss, had made to the Republic Rubber Company. Is this the document?

A. That is the document, I should say.

X Q. 43. I do not want to have any doubt in your mind about it?

A. I believe the cover is missing.

X Q. 44. Well, you identify that as a document that he handed you on that occasion?

A. That, or a copy of it, I believe.

X Q. 45. Did he leave it with you?

A. He did.

X Q. 46. Did you examine it?

A. I did. I examined it in his presence and later.

X Q. 47. I understood you to say that after hearing Kratz's paper you got considerable interest in the subject of accelerators for rubber; is that correct?

A. Before that time I spent most of my time on accellerators for rubber.

X Q. 48. Did that stimulate your interest?

A. My interest could not be stimulated beyond what it was.

X Q. 49. I mean, along any particular lines?

A. Particular lines? Naturally, I was interested in those particular substances which he had mentioned in giving us specific information on.

X Q. 50. Which one?

A. Which one? The guanidine series interested me most of all.

X Q. 51. And from that time on did you take more interest in the guanidine series than you had before?

A. I would not say so. I was interested in the guanidine series.

X Q. 52. Had you yourself discovered the excellence of each member of the guanidine series with reference to its accelerator properties in the curing of rubber?

A. I had not.

X Q. 53. Was Gratz's paper the first knowledge you had in a detailed and scientific way of the facts in that regard?

A. It was the first detailed knowledge.

X Q. 54. Now, it was about six months after that that Mr. Weiss came to apply for a position, was it not?

A. In March.

X Q. 55. And up to that time had your company used diphenylguanidine as an accelerator for rubber?

A. It had not.

X Q. 56. Or any of the guanidine series?

A. We had been studying the guanidine series for some time.

X Q. 57. Since that time has the Firestone Tire & Rubber Company used diphenylguanidine as an accelerator for rubber?

A. It has not.

X Q. 58. Never has used it?

A. Only as we are using it experimentally today.

X Q. 59. Any of the other of the guanidine series or groups or whatever you may call it?

A. We have used other members of the guanidine series.

X Q. 60. Commercially?

A. Yes.

X Q. 61. What are you now using commercially?

By Mr. Edmonds: If your Honor please, I think I will have to object to asking this witness questions about what the Firestone Company is actually using. I cannot think of any ground on which that would have any relation to the issues in this suit, and everyone in this industry has been told of one other patent for which rather extravagant claims

are made, and evidence of the use commercially of such accelerators might have a bearing on issues which arise in some other suit, whereas they could have no bearing in this suit.

By the Court: I will sustain the objection.

X Q. 62. Did you ever test the truth of Mr. Weiss's statements as he made them in this paper?

A. The truth of Mr. Weiss's statements?

X Q. —. Yes; as he made them in this application blank?

A. I did not.

X Q. 64. Did you ever give his application any real consideration whatever or did you just pocket the whole thing?

A. I gave it real consideration.

X Q. 65. Did you write to him and say that his application was refused?

A. I did.

X Q. 66. How long afterwards?

A. I could not say. I should say it was within a week.

X Q. 67. Did you endeavor to ascertain in that period of a week before you turned him down whether at the Republic Rubber Company he had developed a process for the manufacture of thiocarbanilide which is worked successfully now in preference to the old process?

A. I took his word for it, naturally.

X Q. 68. Did you test the correctness by reference to the Republic Rubber Company of his statement that he had lately developed a process for the commercial production of symmetrical diphenylguanidine?

A. I did not.

X Q. 69. Did he say anything more to you specifically about Dr. Kratz than appears on the face of this application to the effect that the value of this product (referring to diphenylguanidine) as an accelerator has been discussed by Dr. Kratz at the Philadelphia Meeting of the American Chemical Society?

A. In bringing up the value of the work he had done on the method of preparation he stated, "Of course, you know that diphenylguanidine is a good accelerator from what you have heard at the Philadelphia meeting."

X Q. 70. And that is the substance of what you understood, is it not, from the statement in this application that

the value of this product as an accelerator has been discussed by Dr. Kratz at the Philadelphia meeting of the American Chemical Society?

A. Yes.

X Q. 71. Have you studied the statements in this application made by Dr. Weiss and in this typewritten report that he submitted to you and which you returned to him to determine whether the statements are correct so far as they refer to diphenylguanidine?

A. Studied? I doubt whether I have ever studied that. I read that report. I believe the statements in it are correct.

By Mr. Cooper: I offer this paper in evidence.

(Marked Plaintiff's Exhibit No. 8.)

Clerk's certificate to foregoing volume of exhibits omitted in printing.

[Caption omitted]

In United States Circuit Court of Appeals for the Third Circuit, October Term, 1926

No. 3470

Dovan Chemical Company, Plaintiff Below, Appellant,

vs.

Coroma Cord Tire Company, Defendant Below, Appellee

On Appeal from the District Court of the United States for the Western District of Pennsylvania

Before Buffington, Woolley, and Davis, Circuit Judges

Opinion—Filed December 7, 1926

Buffington, Circuit Judge:

This case concerns the acceleration of rubber vulcanization. As the patent here involved and the art to which it

appertains has been set forth at length in an opinion reported at 292 Fed. Rep. 555, a case in the Second Circuit involving the same patent and also in the exhaustive opinion of the Court below in this case, reported at 10 Fed. Rep. (2d) 598, we avoid repetition by referring thereto. The proofs show that Morris L. Weiss, the grantee of the patent here involved, was a chemist employed by a rubber company. During the course of his work and moved by a suggestion in Richter's Chemistry, Weiss, in March, 1918, conceived the idea that a well-known laboratory product, diphenylguanidine, known by the chemical symbol D. P. G., and listed by Richter but not as an accelerator, might be used in accelerating the vulcanization of rubber, and then so told Carlton, the chief chemist of the factory. The chemical properties of D. P. G. as a laboratory element, were of course known as an abstract truth, but no one prior to Weiss seems to have conceived and worked out any practical plan by which D. P. G's potential powers could be commercially used. The reason for this is plain for no one knew, or, for that matter, had tried to learn, how D. P. G. could be produced in such quantity as to make possible its commercial use. Having conceived the general idea and made at the factory where he was employed some recorded laboratory experimental work under various dates, Weiss took up the problem of trying out D. P. G. as a vulcanizer and of devising some way to make D. P. G. in such quantity that it could be practically used commercially. The problem was untried and difficult. He first set about making laboratory D. P. G. and in September, 1918, Weiss had produced five grams which by December he had tested with the ordinary rubber batches and found it powerfully accelerated but the rubber product was overcured. However, he was encouraged by them and shortly thereafter his experiments resulted in a perfect cure which was recorded in an experimental book under date of February 10, 1919, a date which as we shall hereafter see is challenged as being changed to that date from September 10, 1919. Under date of February 21, 1919, another successful test, this time with a shoddy compound, was entered in the same book and another with shoddy on March 4, 1919. Those experiments proved the workable worth of D. P. G. as an accelerator in vulcanizing rubber, but Weiss stopped work-

ing further in that line as his supply of D. P. G. had been exhausted. He then turned his attention to discovering some way to make D. P. G. commercially. His efforts in that line resulted in his discovery disclosed and practically utilized in the patent in suit. We here note that he was told he could not get a patent for an accelerator, but, later on, finding he could patent his original discovery, he applied on November 12, 1921 for a patent thereon and on March 28, 1922, was granted the patent in suit, No. 1,411,231. This patent, regularly granted, under the authorities, is prima facie evidence of its validity and unless successfully challenged warrants a decree in this case as infringement is clear.

Such attack is here made and is based on two grounds, viz: first, denial of patentable invention and second, that, if patentable, Weiss was not the original inventor thereof.

Addressing ourselves to the question of patentable invention, we find ourselves in accord with the patent office's action in the grant of the patent. In the first place the worth of D. P. G. as an accelerator is evidenced in its use by the defendant, by the mass of testimony, array of counsel and earnest effort here very properly made to ensure its continued use by this litigation. Its use has been extensive in the art, it has reduced the time of vulcanization, obviated overcuring and increased the character and worth of the product. These elements, while not conclusive, are evidential of its worth in the art. Assuming for present purposes the prima facies of Weiss' patent stands, and the statement in his specification: "I have discovered that disubstituted guanidines particularly diphenylguanidine is particularly effective for this purpose" is true, and if he showed the world in addition how to make this product in commercial quantity in the rubber vulcanizing art, it would seem to us and we so hold, that a claim, such for example as his eighth, viz: "The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine," was inventive in character and valid. In that regard we agree with Judge Manton's holding, when this patent was before him in the Second Circuit, that it involved invention, viz:

"I am satisfied that the use of diphenylguanidine as in the plaintiff's process, involved invention. Using it ad-

vanced the art of rubber making. Its utility and the consequences which followed, fully support the real practical test of the sufficiency of an invention. Where the utility is proved to exist in any degree, a sufficiency of invention to support the patent must be presumed. (Smith vs. Goodyear, 93 U. S. 486.) This substitution involved a new process of manufacture to develop a new use of the properties of diphenylguanidine and there was a new and useful result obtained. (See Smith vs. Goodyear, supra; Rumford Chemical Works vs. N. Y. Baking Powder Co., 134 Fed. 385; Genl. El. Co. vs. Hoskins Mfg. Co., 224 Fed. 464.)"

The process then being new, useful and inventive in character, it remains to inquire whether the prima facies of inventorship which the patent vested in Weiss is overcome by proof of the standard the law requires, that someone else was the inventor thereof. Turning then to the patent to see what Weiss disclosed and, consequently, what alleged prediscoverers must convincingly prove they had discovered and disclosed before him, we note the specification states generally: "The object of my invention is to improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such purpose. * * * I have discovered that di-substituted guanidines particularly diphenylguanidine is particularly effective for this purpose. * * * Down to the time of my researches in accelerators of this type, it was apparently not known that di-substituted guanidines were efficacious or useful as accelerators in vulcanizing, nor that this substance could be produced in sufficiently large quantities in a substantially pure form, or at a sufficiently low cost to be available for this purpose."

The specification then states that in another patent, viz: Serial 482,143, he has disclosed "a process for producing and purifying diphenylguanidine in commercial quantities" and after disclosing fully how, in what proportions and under what heat conditions, the D. P. G. was to be used, Weiss set forth desirable results thereby obtained, viz:

"It will therefore be appreciated that when using the accelerator according to my invention the vulcanization

is accomplished by using comparatively small quantities of the accelerator, thereby obviating undesirable loading or adulteration of the rubber compound. Furthermore, by the use of such accelerator, the texture and durability of the final product is greatly improved and the tendency commonly present in vulcanized rubber to bloom and become brittle with age is greatly reduced if not entirely obviated. My improved accelerator is particularly useful and valuable, where it is desired to produce a harder or less elastic portion in an article leaving other parts which are required to be more elastic and flexible, such as in automobile tires where the beadstock is usually made harder than the body or carcass of the tire proper. The relative amounts of vulcanizing agent and accelerator may be so proportioned that the various parts of a single article may be cured to different degrees of hardness without danger of over-curing the softer or more elastic parts."

It will thus be seen that summarized Weiss' claim of invention was, first, that no one before him had known that D. P. G. was efficacious or useful as an accelerator in commercial vulcanizing; second, no one had known that D. P. G. could be produced in quantity, in pure quality or at a cost to permit its use in vulcanizing; third, that Weiss was the first to solve this second problem by his patent No. 482,143; fourth, that the solution of this second problem enabled him, for the first time in the rubber vulcanizing art, to commercially use D. P. G.

Without entering into details and a discussion of the proofs we may say they satisfy us that Weiss was the first to instruct the rubber art in this mode of rubber vulcanization and that up to his work the rubber art had made no use of D. P. G. in vulcanization and no one had therefore disclosed to the art or instructed it how D. P. G. could be practically produced or, of course, practically used. As showing the foremost advance, knowledge and practice in the rubber art in that regard, we take the exhaustive paper prepared by Dr. G. D. Kratz and his associates and read by him on September 2, 1919, at a meeting of The American Chemical Society in Philadelphia and published in April, 1920, in the Journal of Industrial & Engineering Chemistry. We feel justified in regarding this paper as evidencing not only

the highest point of advance by the art in general but the highest point reached by the three men in their individual prior research and practical results attained. Here was a convention of the leading scientific minds of the rubber industry; here was an opportunity to disclose an invention of vast importance to that art, if it had been made, and to give the public instructions in a novel and untilled field, and in that field, barren of any attempt to use D. P. G. Therefore, to assert inventive priority and to foreclose all subsequent claimants of invention in that regard by there announcing and showing the thing had been done, was now disclosed and the art enabled to now use D. P. G., was an opportunity not to be neglected.

Assuming for present purposes that Dr. Kratz and his associates had conceived the idea of the practical and commercial use of D. P. G. in the rubber art, did this paper so state? Conceiving they had devised some way to make D. P. G. commercially, did the paper tell the art how it could be done? That the paper did not give such information is clear. A contemporaneous report of the meeting and the paper in question made to his company by Williams, a chemical representative of a rubber company, who attended the meeting, may be taken as illustrative of the effect it made on the most highly skilled minds in the art, for after giving an analysis of what the paper meant to him, in which we find no such disclosure as Weiss made in his patents, Williams adds: "The symposium on the action of accelerators which followed was unimportant as every one seemed to try to conceal all he knew on the subject, but obtained all the information possible from others." And indeed that withholding of information from the rubber art, and not disclosure of a workable advance was the very purpose of the paper of the authors and was testified to by one of their number who said:

"We absolutely had no intention of giving any information which any other company or competitor could transpose directly for practical purposes. Our idea, however, did give enough information so that any reputable chemist would be guided by the information in the paper.

Q. Guided to the extent of being put on inquiry, to find out for himself anything you did not say—is that right?

A. Guided to the extent of stimulating investigation along the same lines with which we were pioneering.

Q. And without telling him what to investigate?

A. No, sir. We gave him two tables of what to investigate.

Q. But, I mean, you did not tell him any specific substance to investigate?

A. Well, we gave him two tables of substances, which we pointed out were excellent accelerators.

Q. And he could take his choice from any one of the substances mentioned in the two tables?

A. Absolutely.

Q. And go on investigating for himself?

A. Yes, sir, because there is no one accelerator of universal application or universal quality."

And this estimate by Dr. Kratz of the purpose of the paper, namely, an invitation to experimental research, is evidenced by what influence the paper had in the case of Weiss personally Daniels, who was Weiss' Chief, attended the meeting in Philadelphia and took notes of the tables in the paper, and on his return, as he testified, he did "immediately tell Weiss that the statements made in the paper read by said Kratz confirmed our experience with D. P. G. as to accelerating, and that we should continue to work on that substance and develop a commercial process if possible."

It will thus appear that the paper of Kratz and his associates had no effect on the working art. No one made any practical use of it. No one in the art selected D. P. G. from the several accelerators named in its tables and used it in the vulcanization of rubber. No special emphasis was laid on D. P. G. in comparison with other substances so named and it is quite evident that if advance in the art had stopped with the Philadelphia paper the art would not have had the information and advance disclosed by Weiss in his patent specification and would not have made the successful advance which followed Weiss' disclosure. Such being the negative results produced by the paper, we cannot accede to the proposition that its theoretical statements, valuable as they were, forestalled or even fore-shadowed the clearcut, practical conception which Weiss then purposed and which he later practically worked out, namely the

successful pioneer making of D. P. G. commercially and when made successfully and pioneeringly using it in the rubber vulcanizing art.

In arriving at the conclusion that the prima facies of Weiss' patent has not been met, we deem it proper to say that while we have not discussed, we have not overlooked, the many other matters disclosed in the proofs and argued by counsel. We have only discussed what we regard as its decisive features but we deem it proper to say, without discussing the evidence, we have reached the conclusion that the time date of entry by Weiss in the experiment book was February 10, 1919, as contended by the plaintiff and not September 10, 1919, as contended for the defendant. We deem it proper to say also that we have not discussed the technical contents of the Philadelphia paper for two reasons; first, our technical inability to do so; and second, the needlessness of doing so, had we been able, because for the purposes of this case, we have the evidence of its reader, uncontradicted by his associates, that its purpose was not to disclose a useful, workable process, but on the contrary not to do so.

In reaching the conclusion we have we regret to find ourselves at variance with those reached by two Circuit Judges of the Second Circuit, reported at 292 Fed. Rep. 555, heretofore referred to, but such regrettable divergence of view is lessened by the fact that the views of two other Circuit Judges of that Circuit are in accord with our own.

So holding, the decree entered below will therefore be reversed and before the mandate goes down an opportunity will be given counsel to agree as to its form.

Woolley, Circuit Judge, dissents.

[File endorsement omitted.]

IN UNITED STATES CIRCUIT COURT OF APPEALS

[Title omitted]

Appeal from the District Court of the United States, for the Western District of Pennsylvania

DECREE—Filed December 7, 1926

This cause came on to be heard on the transcript of record from the District Court of the United States, for the Western District of Pennsylvania, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged, and decreed by this Court that the decree of the said District Court in this cause be, and the same is hereby reversed, with costs.

Philadelphia, December 7, 1926.

Per Curiam:

Buffington, Circuit Judge.

[File endorsement omitted.]

Petition for rehearing, covering 15 pages, filed January 7, 1927, omitted from this print. It was denied and nothing more by order January 26, 1927.

IN UNITED STATES CIRCUIT COURT OF APPEALS

[Title omitted]

ORDER DENYING PETITION FOR REHEARING—Filed January 26, 1927

And now, to wit, January 26, 1927, after due consideration, the petition for rehearing in the above-entitled case is hereby denied.

Philadelphia, —— —, ——.

Per Curiam:

—— ——, Circuit Judge.

[File endorsement omitted.]

Clerk's certificate to foregoing transcript omitted in printing.

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed April 11, 1927

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Third Circuit is granted. And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

Endorsed on cover: File No. 32,482. U. S. Circuit Court of Appeals, Third Circuit. Term No. 182. Corona Cord Tire Company, petitioner, vs. Dovan Chemical Corporation. Petition for writ of certiorari and exhibit thereto. Filed February 21st, 1927. File No. 32,482.

(16)

SUPREME COURT OF THE UNITED STATES.

No. 182.—October Term, 1927.

Corona Cord Tire Company, Petitioner, *vs.* Dovan Chemical Corporation.	On Writ of Certiorari to the United States Circuit Court of Appeals for the Third Circuit.

[April 9, 1928.]

Mr. Chief Justice Taft delivered the opinion of the Court.

This is a bill by the Dovan Chemical Corporation against the Corona Cord Tire Company to enjoin infringement of a patent issued to Morris L. Weiss, assignor of the Dovan Chemical Corporation. The District Court for the Western District of Pennsylvania dismissed the bill for lack of validity of the patent. 10 Fed. (2d) 598. The dismissal was reversed and the patent and the infringement charged were both sustained by the Circuit Court of Appeals for the Third Circuit. 16 Fed. (2d) 419. A writ of certiorari was granted April 11, 1927 (273 U. S. 692), because in the prior case of *Dovan Chemical Corporation* v. *National Aniline & Chemical Company*, 292 Fed. 555, the Second Circuit Court of Appeals had reversed the decree of the District Court for the Southern District of New York (not reported) in favor of the Dovan Corporation and had held that the patent was invalid on the ground that Weiss was not the first discoverer.

The patent in suit relates to the vulcanization of rubber. Vulcanizing consists in mixing a small amount of sulphur with rubber and subjecting the mixture to heat for a period of time, during which a chemical combination of the rubber and sulphur takes place and commercial rubber is made. The patentee recites that the object of his invention is to "improve rubber compounds so that the finished product shall be of superior quality and so that the time required for vulcanization shall be greatly reduced over that ordinarily required for such a purpose. It is known that when certain organic substances are added to the rubber mix during the compounding, a catalytic or similar action is produced which

causes the rubber or similar gum to unite or react more rapidly and thoroughly with sulphur or other vulcanizing agents". The patentee continues:

"I have discovered that disubstituted guanidines, particularly diphenylguanidine, is particularly effective for this purpose." (This substance is indicated by the formula given in the patent.)

He says further:

"I am aware that triphenylguanidine has been suggested, and probably used to some extent, as an accelerator in the vulcanization of rubber, but the use of diphenylguanidine for that purpose appears to have been unknown prior to my researches on this substance.

"I have found that diphenylguanidine is much more powerful and efficacious as an accelerator in vulcanization than triphenylguanidine. For example, in the vulcanization of hard rubber articles the use of diphenylguanidine not only hastens the vulcanizating action but results in a final product much superior in texture, strength, durability and aging qualities over that when the triphenylguanidine is used."

The patentee makes a short reference to a formula by which he produces the rubber mix, in which he says:

"The rubber may be compounded in the following proportions: 50 parts by weight of new rubber, 45.5 parts by weight of zinc oxide, 3.5 parts by weight of sulphur, 1 part by weight of diphenylguanidine. These are mixed together in any suitable way, such as by milling, and then vulcanized or cured in the usual molds or otherwise under heat corresponding to a steam pressure of about 40 lbs. per square inch. This vulcanizing temperature should be continued until the compound is suitably vulcanized, which requires from 10 to 20 minutes depending upon the shape and size of the articles being vulcanized."

The patent contains twelve claims. Those mainly relied on are: the fourth, for "The process of treating rubber or similar materials which comprises combining with the rubber compound diphenylguanidine"; the eighth, for "The process of treating rubber or similar materials, which comprises combining with the rubber compound a vulcanizing agent and diphenylguanidine"; and the twelfth, for "A vulcanized compound of rubber or similar material combined with a vulcanizing agent and diphenylguanidine".

Vulcanizing is old and well known. Its present high state of development represents an evolution of about 80 years. Practically all rubber must be vulcanized for commercial use. The amount of sulphur in the mixture is comparatively small, as for instance 4

to 10 parts of sulphur to 100 parts of rubber. The remainder of the mixture may be all rubber or it may be partly rubber and partly other ingredients such as fillers and pigments, the other ingredient used most widely being zinc oxide. In the manufacture of automobile tires a considerable proportion of zinc-oxide is generally used. A very old and well known proportion has been fifty parts of rubber, forty-five parts of zinc oxide and five parts of sulphur and is the one shown in the specification of the patent. The mixture is "cured" by subjecting it to heat to make the vulcanized rubber of commerce. Platen molds have to be provided for giving the desired form to the rubber vulcanized. Steam has to be supplied for heating the molds and the rubber mix, during the "cure." A "cure" is the successful completion of the chemical union or vulcanization of the rubber with the sulphur. The fact of a successful "cure" for practical purposes is established by a simple and short method called the thumb and tooth test. By this test, rubber chemists settle the fact and determine by the resulting product the satisfactory quality of the stock or the mix for vulcanization and they become expert at it. If by this test the product is not well united chemically, it is said to be "under cured" or "over cured", and then the operator changes the ingredients or the time of the process. When it is important to determine with greater exactness the tensile strength and degree of elacticity or other qualities of the product, a special machine measure or test is used, but the thumb and tooth test is the frequent way of knowing a cure and it is a satisfactory one for every day use in business.

It has been long known that a "cure" can be hastened by mixing with the ingredients a small quantity of what is called an accelerator or vitalizer. Inorganic substances like lime or litharge were originally employed as such but it was subsequently found that certain organic substances were more powerful or more "active" as the term is, and they came into more general use. The heat to which the rubber mixed with sulphur is subjected has a deleterious effect upon the substance of the raw rubber, and the longer the heating, the greater the injury. An accelerator, as it lessens the time of the cure, not only increases the output of the equipment used but reduces the danger of deterioration of the product. An accelerator thus improves the elasticity, tensile strength, and other desirable commercial qualities of the finished product. It is not fully understood what the vitalizing or catalytic action of the accelerator is, but its existence and its results have long been known.

The patentee in his specifications speaks of triphenylguanidine and compares its operation as an accelerator with that guanidine, the utility of which as an accelerator he claims to have discovered, called diphenylguanidine. Guanidines are a group of organic substances which have become prominent and important in this quest for useful accelerators. The monophenylguanidine and the diphenylguanidine and the triphenylguanidine are closely related chemically. Their long names, used to indicate the variation in the component elements, have been shortened so that it is usual to refer to diphenylguanidine by letters as "D. P. G." and the triphenylguanidine as "T. P. G."

So closely do the chemical compositions of these two resemble each other that the petitioner contends that the patent is invalid because the utility of D. P. G. as an accelerator was plainly indicated by general chemical knowledge and did not involve patentable discovery after T. P. G. had proven to be a good one for this purpose. But we can not agree with this view. The catalytic action of an accelerator can not be forecast by its chemical composition, for such action is not understood and is not known except by actual test.

The respondent attempts to show that the resulting improvement in the rubber product by the use of diphenylguanidine was something different from that in the use of other accelerators. The good results of the use of diphenylguanidine are chiefly or wholly due to its greater activity and the lessened time of the cure. The expert evidence seems to show that T. P. G. as an accelerator develops the same desirable qualities, set forth on behalf of respondent, in the vulcanized rubber as does D. P. G., except that the cure of the latter is more rapid with its to be expected advantages. Moreover, claims of peculiar usefulness of D. P. G. in other than its "activity" and speed as an accelerator, even if proven, could not in any degree affect the issue in this case. If employment of D. P. G. as a useful accelerator was a discovery by Weiss, prior to anyone else, Weiss, or his assignee, is entitled to all the advantages that flow from that increased activity or from any other quality in its use as such. *Roberts* v. *Ryer,* 91 U. S. 150, 157; *Stow* v. *Chicago,* 104 U. S. 547, 550; *Lovell Mfg. Co.* v. *Cary,* 147 U. S. 623, 634.

It does not, on the other hand, give Weiss any more right to appropriate D. P. G. as an accelerator because he may have elaborated

in his specifications other advantages from its use than if he had not mentioned them. Nor, on the other hand, does it minimize or affect the priority of completed discovery by some one else before Weiss that the prior discoverer may not have perceived and stated all the advantages of an earlier use of D. P. G. as an accelerator.

Judge Hough, of the Second Circuit, truly said therefore that this patent meant, condensed in one sentence: "I claim the use of D. P. G. as an accelerator, because I was the first person who observed its efficacy for that purpose". Similarly, the examiner in the Patent Office who allowed the patent said that Weiss' application was "no more than a broad disclosure of the use of [D. P. G.] without disclosing any details other than those usually employed with accelerators of this class."

The patent in suit was applied for November 12, 1921, and was granted March 28, 1922. Weiss had referred in the specifications of this patent to another patent of his which was applied for July 2, 1921, and granted July 11, 1922. This latter patent was for a process for making D. P. G. in large or commercial quantities. In the application for that patent, the patentee pointed out that before his process was discovered D. P. G. could not be made except in small quantities for chemical research because the cost was prohibitive. The validity of the Weiss patent for a process in making diphenylguanidine is not attacked. The new patented process by reason of the lessened cost has resulted in the very great use of D. P. G. for commercial purposes and has been very profitable. But the purpose of securing the patent in suit and maintaining its validity is more ambitious. It is not to protect and preserve the new process already being safely enjoyed, but it is to prevent the use of D. P. G. as an accelerator, however made by any process that may be subsequently discovered. It is to enlarge a monopoly of D. P. G. as an accelerator, and is thus in effect to discourage effort to find other and cheaper means of making it. What we have to decide here is not the priority of discovery of the cheap process of making the accelerator D. P. G., which it is conceded Weiss invented, but whether he was the first person to discover the efficacy of D. P. G. as an accelerator whether made by any process, cheap or costly.

We feel it necessary to call attention to a lack of relevancy of Weiss' successful process patent in the case before us, because the

majority opinion in the Circuit Court of Appeals seems to us erroneously to have confused the credit due to Weiss for the process patent, already conceded, with his right to his present claim of entire monopoly of the use of D. P. G. as an accelerator.

The issues and the evidence in this case can not be considered and discussed without reference to a paper read by Dr. George Kratz, a rubber chemist, at the Philadelphia meeting of the American Chemical Society between the 2nd and the 6th of September, 1919. It was entitled "The Action of Certain Organic Accelerators in the Vulcanization of Rubber", and was a review of the comparative excellence of a number of well-known and used accelerators, as well as that of D. P. G. with T. P. G., in which he found D. P. G. to be very much more active than T. P. G. Then under an experimental part he described the kinds of rubber used, the proportions of rubber and sulphur in the mixture, and the manner in which the accelerator was incorporated and the method of vulcanization. He said:

"The rubber used was good quality, first latex, pale crepe, and the same lot was employed in all mixtures. All mixtures were made under standard conditions; the average time of each batch on the mill was 17.5 min. The same proportion of rubber and sulphur—92.5 parts rubber, and 7.5 parts sulphur—was employed in each instance, but the amount of accelerator was varied, according to the conditions of the experiment.

"All the accelerators soluble in alcohol were dissolved in the smallest quantity of this liquid and introduced into the rubber in solution. Those not soluble—and this applied to the anhydroformaldehyde bodies only—were ground to 100 mesh and added to the rubber with the sulphur. After mixing, the mixtures were allowed a recovery period of 24 hrs. before they were vulcanized. Vulcanization was carried on in a platen press of the usual type."

"Table 1.—Relative Activities—Thiourea Series.

"Parts required to Equal one Part Aniline.

"Aniline	1.000
Urea	0.250
Thiourea	0.300
Monophenylthiourea	0.450
Diphenylthiourea	0.850
Monophenylguanidine (a)	0.075
Diphenylguanidine (Sym.)	0.075
Triphenylguanidine	0.500"

The activities of the various substances were compared in the mixture previously mentioned—92.5 parts of rubber and 7.5 parts

of sulphur—taking as a standard the effect obtained with one part of aniline, vulcanized for 90 min. at 148° C. The amounts of various substances in the urea series required to effect the same degree of vulcanization as obtained with one part of aniline are shown in Table 1.

The paper thus shows that the activity and superiority of D. P. G. as an accelerator over T. P. G. is approximately as 7 is to 1.

In the answer to the bill in this case, the Kratz paper was set up as a defense, but although read before September 6th, 1919, it was not published until April, 1920.

Under Section 4886, Revised Statutes, a person who claims to have invented any patentable improvement, is not to be denied a patent because of any printed publication before his discovery, not in public use or on sale for more than two years prior to his application. Kratz's article was not printed until less than two years before Weiss' application for a patent in November, 1921, and therefore the paper could not be used as a basis for defense against his patent. It nevertheless plays a very important part in understanding the facts in this case.

The main and only issue here is divided, by reason of the evidence and the lines of argument pursued, into two parts. The first is the effect of that part of it devoted to Weiss' discovery and his reduction to practice. The second is that part devoted to Kratz's discovery and his reduction to practice.

First. It is contended by the petitioner that the file wrapper and evidence show, that the patent was secured by false evidence and is not entitled to the presumption of validity which ordinarily accompanies the grant. The examiner in the Patent Office three times rejected the Weiss application by a reference to the Kratz paper. The hearing on that reference was ex-parte. The third rejection was followed by acquiescence by the examiner because of two affidavits, one by Weiss and one by his fellow chemist Daniels who claimed to have been with him at the time in the laboratory of the Republic Rubber Company of Youngstown. In these final affidavits, Weiss had said that D. P. G. was produced and actually used "in the vulcanization of rubber goods" during the early part of the year 1919, and Daniels said, "These tests were also carried out in the compounding laboratory for the various departments of the Republic Rubber Company at Youngstown, Ohio, and the accelerator proved to be highly efficient in the actual vulcanization

of rubber goods, such as hose, tires, belts, valves and other mechanical goods." It now appears, without contradiction, that the only rubber Weiss made during the early part of the year 1919 from D. P. G. was test slabs of rubber in which D. P. G. was the accelerator, and that in fact neither he nor anybody in the Rubber Company had vulcanized rubber goods, as Daniels described them, before the Kratz publication. But we do not think this would invalidate the patent for the reason that the actual fact was that these test slabs of rubber with D. P. G. if proven to be properly vulcanized, as the evidence seems to show it was, was a demonstration of the utility of D. P. G. as an accelerator and was a completed and demonstrated discovery constituting reduction to practice. Production of rubber-goods for use or sale was not indispensable to the granting of the patent. Hence the affidavits, though perhaps reckless, were not the basis for it or essentially material to its issue. The reasonable presumption of validity furnished by the grant of the patent therefore would not seem to be destroyed.

Then it is claimed that the reference to the Kratz paper which was not attacked by the applicant for its insufficiency as a reference under Section 4886 of the Revised Statutes, should be treated as equivalent to a prior patent, the priority of which could only be overcome by evidence eliminating all reasonable doubt. *The Barbed Wire Patent,* 143 U. S. 275; *Deering* v. *Winona Harvester Works,* 155 U. S. 286, 300; *Clark Thread Company* v. *Willimantic Linen Company,* 140 U. S. 481, 489. But the Kratz paper was not a prior patent, and while it may be that other circumstances such as a reference to a publication made more than two years before the application for the patent may sometimes have the effect to require the same convincing proof of earlier discovery to avoid its effect (*Westinghouse, etc. Co.* v. *Catskill, etc. Co.,* 121 Fed. 831, 834; *New England Motor Co.* v. *Sturtevant Co.,* 150 Fed. 131, 137; *Wendell* v. *American Laundry Machinery Co.,* 248 Fed. 698, 700), we do not think that the mere failure to invite the attention of the examiner to the defect of the reference under Section 4886, Revised Statutes, calls for the strict rule of proof to avoid the reference. This conclusion keeps the burden of proof on the defendant in attacking the patent on the ground of a prior use.

It is also claimed that because the trial court in this cause found, after hearing the witnesses, the weight to be with the pe-

titioner and against Weiss, assignor of respondent, his conclusions of fact except for manifest error, are to be treated as unassailable. *Adamson* v. *Gilliland,* 242 U. S. 350, 353; *Davis* v. *Schwartz,* 155 U. S. 631; *Kimberly* v. *Arms,* 129 U. S. 512; *Tilghman* v. *Proctor,* 125 U. S. 136, 149; and *Mason* v. *United States,* 260 U. S. 545, 556. We do not think that this rule applies in the case because us at least to its full extent, first, for the reason that the Circuit Court of Appeals, having considered all the evidence upon which the trial judge reached his conclusion, declined to approve of his findings, and second, because in the *National Aniline & Chemical Co.* case, which is in conflict with the case here, the trial judge reached a different conclusion on the same issue and the same evidence which we have here. *Thompson Spot Welder Co.* v. *Ford Motor Co.,* 265 U. S. 445, 447. We think, therefore, that the respondent is entitled under these conditions to retain a presumption of validity for his patent in the consideration of the case before us. This brings us then to the evidence which Weiss adduces in support of his first discovery of D. P. G. as an accelerator.

Morris L. Weiss received a degree in chemistry from the Cooper Union of New York City late in 1917, and attended a course of chemical study in the Polytechnic of Brooklyn. He entered the employ of the Republic Rubber Company of Youngstown, Ohio, in October, 1917. That company manufactured rubber articles largely from shoddy or re-claimed rubber. It was seeking to find an improved accelerator in T. P. G. and was building a plant for its commercial use. Weiss, in addition to his usual work in T. P. G., became interested in 1918 and 1919 in the possibilities of the use of D. P. G. as an accelerator which he had inquired into because it was mentioned with T. P. G. among the guanidines in a text book of chemistry which he had read. He was required by the rules of the company to enter his experiments in a book called the "X Book", kept for the purpose. During the term of his employment, prior to September 6, 1919 (the date of Kratz's reading his paper), this X Book showed three dated and recorded experiments with D. P. G. as an accelerator. Two of these were with a shoddy mixture and there is doubt whether they showed the marked superiority of D. P. G. over T. P. G., as Weiss in another case seems to have admitted. But there was another test with pure rubber recorded in the X Book, of successful vulcanization by D. P. G., the date of which is in dispute. It was as follows:

Number X 2034
Made for Accelerator tests—

	E
	50
D. P. G.	1
Sulphur	4
Zinc	43
M. G. O.	2
	100
Cure	20/30
Stretch	141/2
Strength	3000
Set	1/2
Date	2.10.19

As it appears now, the date is February 10, 1919. Weiss does not deny that first figure of the date has been changed, but says that it was probably changed because it was made originally by mistake as a "1", as on January 10, 1919, when it ought to have been as a "2", as in February, and the change was only to make it one month later. It is contended on the other side, and it was testified by an expert on handwriting and the District Judge so held, that the change was made from 9-10-19 to 2-10-19, which would carry the original and correct date of this test to the later date of September 10, 1919, or three or four days later than the reading of the paper by Dr. Kratz to the American Chemical Society, and after Weiss had been informed by his colleague Daniels of Kratz's blackboard statement of the results of his discoveries. Weiss says he made other tests between the first successful one and the reading of the Kratz paper, but they are not recorded under specific dates, nor are they in regular order. There is a record of many tests after the Kratz paper, but none others are shown to be before it except by Weiss' and Daniels' unassisted memory.

Then it is said he did not claim discovery until his application for this patent in November, 1921, while in an application for employment as a chemist at another rubber company in March, 1920, he did claim credit for the new process in commercially making D. P. G., but he attributed its importance to the revelation of the Kratz paper. His explanation is that he then supposed that accelerators were not patentable and he was absorbed in cheapening the production of D. P. G.

Other circumstances are detailed at length in the brief of counsel to show that Weiss' real knowledge of the use of D. P. G. as an

accelerator was prompted by Kratz's paper and could not be independent discovery on his part before his hearing of and reading it. But after full consideration of all the doubt-giving circumstances we do not think that the attack on Weiss's proof of February 10, 1919, as the date when he first discovered by a completed experiment the successful use of D. P. G. as an accelerator in making rubber has overcome the evidence given to support it and the presumption of its correctness from the patent itself.

Second. Kratz's discovery.—Dr. Kratz had been engaged in the chemistry of rubber and in its manufacture for more than seven years. He read his paper on D. P. G. and other accelerators in September, 1919. He had been employed as a chemist with the Diamond and Goodrich Companies, and, subsequently, with the Norwalk Tire and Rubber Co. of Connecticut, for several years, and after April, 1917, with the Falls Rubber Company, of Cuyahoga Falls, near Akron, Ohio. He had directed his efforts to the subject of vulcanization almost exclusively and was intimately familiar with the commercial practice therein. His first work with accelerators was as research chemist in 1913. On April 1, 1914, he went with the Norwalk Company in the capacity of chemist, and in April, 1917, he became chief chemist of the Falls Rubber Company.

In 1916, while with the Norwalk Company, Kratz prepared D. P. G. and demonstrated its utility as a rubber accelerator by making test slabs of vulcanized or cured rubber with its use. Every time that he produced such a slab he recorded his test in cards which he left with the Norwalk Company and kept a duplicate of his own. By these tests he arrived at figures representing the degree of superiority of D. P. G. over T. P. G. and other known accelerators, so that he could determine exactly how much D. P. G. it would be necessary to use to produce the same accelerating effect as would be produced by a larger amount of T. P. G. or of other accelerators in the same time. This work was known to, and was participated in, by his associate in the Norwalk Company, his immediate superior and the chief chemist of the Company, Dr. Russell, who fully confirms Kratz's records and statement. This work was finally recorded in a carefully prepared contemporaneous report which Kratz left in the files of the Norwalk Company, and which is now produced by Dr. Russell in evidence before us. When Kratz left the Norwalk Company to go to the Falls Rubber Company, he took with him this record for his use in his future work,

so that there are two records of the same thing. The report in 1916 was as follows:

"XI/1/16 G. D. K.

Relative Catalytic Effect of Compounds Related to Sulpho Carbaninide.

"The following formula was used to try out the activity of various substances more or less closely related to sulpho-carbaninide:

White Para	100
Zinc oxide	100
Sulphur	5

"The following effects were recorded and, in cases where an acceleration was produced, the amounts required to give a cure in one hour equal to the cure produced by 3% of S-Carb, were as follows [in the first column]:

		[As shown in Chemical Society Paper, Sept., 1919
"Aniline	3.50%	3.5
Di phenyl thio urea	3.0%	2.975
Mono phenyl thio urea	1.5%	0.262
Thio urea	1.0%	1.050
Tri phenyl guanidine	1.75%	1.750
Di phenyl guanidine	0.25%	0.262
Urea	0.33%"	0.875]

These results were confirmed by Kratz at the Falls Rubber Company in 1918, and 1919, and were reported in his paper at the Chemical meeting in September of 1919 as shown in the second column above, multiplied by 3.5 in order to put them on the same basis.

These values were determined by Kratz in some eight or nine tests in 1916 with each of the substances named, for which test slabs were made in each instance, and the series was extended until the desired result was obtained. The first substance is aniline and the second is thio (diphenylthiourea). These substances were generally known and widely used as accelerators and therefore were used as standards of comparison. They show that Kratz's tests taught him in 1916 that D. P. G. was seven times as strong and as active as T. P. G. The report to the Norwalk Company also shows two different formulas by which Kratz made his own D. P. G. in 1916.

In the fall of 1917, when Kratz was chief chemist of the Falls Company, he received a special order for 1000 inner tubes for automobile tires. In filling three hundred tubes, of this order of

1000 tubes which were made under Kratz's personal supervision—for he had then become chief chemist of the Falls Company—he used D. P. G. as an accelerator.

A little later in 1918 and 1919, Kratz conducted at the Falls plant a series of tests with D. P. G. closely paralleling the series of tests which he had made in 1916 at the Norwalk plant and confirming those already reported as above. At Norwalk he had used mostly zinc oxide as part of the rubber mix and he desired to verify the results obtained in tests of the same accelerators in other compounds of rubber with other than zinc oxide. All this was part of the preparation of his paper on accelerators to be read before the 1919 meeting of the American Chemical Society. The year before he had attended the 1918 meeting of the Society expecting to hear the subject discussed but nothing was said and so he and his assistant, Flower, gathered their material for a paper at the next meeting. That paper as read covered much more than the mere demonstration of the utility of D. P. G. as an accelerator. It dealt with a number of other accelerators also. The authenticity and reliability of Dr. Kratz's testimony about them is not questioned in this record. It is not too much to say that the report of Dr. Kratz's results made a great impression upon the rubber chemists of the country.

The only lack of corroboration of Kratz and the only challenge to his testimony of fact in this case is in reference to his account of sending to a customer the 300 inner tubes for automobile tires accelerated by D. P. G. He says that they were sent to the purchaser whose name he gives and that they proved to be satisfactory, as he knew by having tagged them and having received approval of the whole lot by the purchaser. He says that this was a special order; that he had at the time a small supply of D. P. G. which he himself had made; that these 300 tubes exhausted his supply and that in filling the remainder another accelerator was used. This sale and the use of D. P. G. as an accelerator took place in August, 1917, as shown by the memoranda that Kratz produces. The record of the shipment of the 1,000 tubes, the memorandum shipping order by Kratz and the O. K. by the President of the Falls Company are introduced.

Kratz says he did not tell anyone of his use of D. P. G. in these 300 tubes. This is urged by respondent as a reason for discrediting it. Were this an isolated instance not taken out of the history of all of Kratz's relation to accelerators and to D. P. G., it might reason-

ably give rise to such question. But the undoubted fact that Kratz had demonstrated the utility of D. P. G. in his eight or nine tests in 1916 at Norwalk and the corroboration of Dr. Russel as to his work there, and the memorandum which he had taken with him of the tests and of the report to the Falls Rubber Company, and, indeed, the reflexive corroboration of his paper at Philadelphia, show undoubtedly that he knew the excellence of D. P. G. as an accelerator, and tend to confirm his account as to the 300 tube sale. It was not unnatural that with a small amount of D. P. G. he should try it in a special order of this kind from which he might confirm the conclusion he had already reached. The effort to disprove it was vague and inconclusive, which, it is only fair to say, was to be expected five years after the event.

Kratz was not seeking a patent. He inferred, with reason, that D. P. G. would not make a successful business accelerator because of its then cost. He is wholly disinterested pecuniarily in the result of this case. The fact that he is the only witness is not fatal or any reason for denying its weight in connection with other circumstances. *Reed* v. *Cutter,* 1 Story, 590, Fed. Cas. No. 11,645, 20 Fed. Cas., 435; *Coffin* v. *Ogden,* 18 Wall. 120; *Egbert* v. *Lippmann,* 104 U. S. 333.

But even if we ignore this evidence of Kratz's actual use of D. P. G. in these rubber inner tubes which were sold, what he did at Norwalk, supported by the evidence of Dr. Russell, his chief, and by the indubitable records that are not challenged, leaves no doubt in our minds that he did discover in 1916 the strength of D. P. G. as an accelerator as compared with the then known accelerators, and that he then demonstrated it by a reduction of it to practice in production of cured or vulcanized rubber.

This constitutes priority in this case. It was not followed by commercial use thereafter, because of the then cost of D. P. G. But this patent is for the mere discovery and application in the making of rubber of a particular accelerator. It was the fact that it would work with great activity as an accelerator that was the discovery, and that was all, and the necessary reduction to use is shown by instances making clear that it did so work, and was a completed discovery. *Bedford* v. *Hunt,* 1 Mason, 302, Fed. Cas. No. 1217, 3 Fed. Cas., 337; *Reed* v. *Cutter, supra; Gaylor* v. *Wilder,* 10 How. 477; *Coffin* v. *Ogden, supra.*

It is said that these tests of Kratz were mere abandoned laboratory experiments. There was no abandonment in the sense that Kratz had given up what he was seeking for in demonstrating a

new and effective accelerator in D. P. G. If he had been applying for a patent for the discovery, he clearly could have maintained proof of a reduction to practice. A process is reduced to practice when it is successfully performed. A machine is reduced to practice when it is assembled, adjusted and used. A manufacture is reduced to practice when it is completely manufactured. A composition of matter is reduced to proctice when it is completely composed. Walker on Patents, § 141a. *Hunter* v. *Stikeman,* 13 App. D. C. 214, 226; *Mason* v. *Hepburn,* 13 App. D. C. 86, 92; *Lindemeyer* v. *Hoffman,* 18 App. D. C. 1, 5; *Roe* v. *Hanson,* 19 App. D. C. 559, 564.

Nor were the tests of Kratz abandoned laboratory experiments. If so then the cure by Weiss tested in February, 1919, was of the same character and was not of itself a reduction to use. Weiss showed his production of vulcanized rubber with D. P. G. in February, 1919, only by a so-called laboratory experiment. He demonstrated the value of D. P. G. as an accelerator by exactly the same kind of experiment as that which Kratz had used two years before. Weiss founded his claim on the cured slab of rubber which had been vulcanized with D. P. G., and this Kratz had done two years earlier with slabs of the same kind and composition deposited in the same way in a platen mold.

Kratz's method of testing his rubber slabs is criticized. As already said, it is the method known as the thumb and tooth test. This is not so exact a method in determining all the qualities that a test machine would show in the product, but it is, as already said, one very generally used for practical purposes in factories in determining that the vulcanization or cure is complete. It was the one by the use of which Kratz disclosed and demonstrated to the rubber chemists of the country who listened to him in September, 1919, that D. P. G. was an accelerator and how powerful it was as compared with others, and thereby revolutionized knowledge in the art as the evidence abundantly shows and as Weiss himself asserted in his application for employment in 1920. It is true that in the test by Weiss of February 10, 1919, the details of tensile strength and time of cure and elasticity were disclosed by machine test with more particularity but the speed of the cure and the "activity" of D. P. G. and the fact of the cure were clearly shown by the simpler test.

It is a mistake to assume that reduction to use must necessarily be a commercial use. If Kratz discovered, and completed

as we are convinced that he did, the first use of D. P. G. as an accelerator in making vulcanized rubber, he does not lose his right to use this discovery when he chooses to do so for scientific purposes or purposes of publication or because he does not subsequently sell the rubber thus vulcanized or use his discovery in trade or does not apply for a patent for it. It is not an abandoned experiment because he confines his use of the rubber thus produced to his laboratory or to his lecture room. It is doubtless true that Kratz by his course in respect to his discovery as to the use of D. P. G. has abandoned any claim as against the public for a patent, but that is a very different thing from saying that it was abandoned as against a subsequent discoverer or patentee.

The conclusion we reach then is that, so far as this record shows, the first discovery that D. P. G. was a useful accelerator of the vulcanization of rubber was made by George Kratz and not by Weiss.

We come then to the question of the validity of Claims 1, 5 and 9 of the patent, which seek to appropriate to the patentee the process of treating rubber by combining with the rubber compound "a disubstituted guanidine." Now the class of disubstituted guanidines includes not only D. P. G. but all other derivatives of guanidine in which two of the hydrogen atoms of guanadine nucleus have been substituted by other groups. The fact that disubstituted guanidines have been used as accelerators appeared in an article published by one Du Bosc, July 15, 1919, a fact which would defeat the claims applied for November 24, 1921. Moreover, the experts show that there are between fifty and one hundred substances which answer this description, of which there is quite a number that are not accelerators at all. Weiss could certainly not claim the entire group of such compounds. He makes no showing that there is any general quality common to disubstituted guanidines which made them all effective as accelerators. Claims for their exclusive use cannot therefore be sustained. This is shown by the decision of this Court in the *Incandescent Lamp Patent*, 159 U. S. 465, where the Court said, at page 475:

"If, as before observed, there were some general quality, running through the whole fibrous and textile kingdom, which distinguished it from every other, and gave it a peculiar fitness for the particular purpose, the man who discovered such quality might justly be entitled to a patent; but that is not the case here".

Reversed.